NAVY INSTALLATION RESTORATION PROGRAM PLAN
NAVAL AIR STATION
JACKSONVILLE, FLORIDA

September 1991

VOLUME 4
Basic Site Work Plan

1 of 2

13-0019 IRPP VOL 4: BSWP1

SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
P.O. BOX 10068/CODE 182
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INSTALLATION RESTORATION PROGRAM PLAN
NAVAL AIR STATION
JACKSONVILLE, FLORIDA

VOLUME 4
BASIC SITE WORK PLAN (BOOK 1 OF 2)

RECORD OF DOCUMENT CHANGES

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Appendix 4.2 Data Analysis Plan		
Data Validation Process & Org 1.0	Pages 1–2 thru 1–5	Pages 1–2 thru 1–5
Materials for Validation 2.0	Pages 2–1 thru 2–2	Pages 2–1 thru 2–2
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Resolving Problems 6.0	Pages 6–1 thru 6–2	Pages 6–1 thru 6–2
Appendix 4.4.1 QAPP		
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NAVAL AIR STATION
JACKSONVILLE, FLORIDA

VOLUME 4
Basic Site Work Plan
1 of 2

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13-0019 - IRPP VOL 4: BSWP

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The Basic Site Work Plan documents procedures to be used during all field investigations and analytical testing during the IRP at NAS, Jacksonville. The plan contains a Basic Sampling and Analysis Plan (BSAP), including a Basic Field Sampling Plan (BFSP), which outlines standard operating procedures (SOP) during field investigations, and a Quality Assurance Program Plan (QAPP), which outlines procedures which will be used during sampling, decontamination, and analytical testing.

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Organization and Planning documents procedures to be used for implementing the IRP of NAS, Jacksonville. The plan outlines program organization, data management, community relations, and health and safety tasks. The document also provides a summary of background information on the potential sources of contamination and environmental setting of the Site.

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ACRONYM LIST

ACS - American Chemical Society.

AI - Adsorption Isotherm.

AOC - Area of Contamination.

AQA/LCP - Analytical Quality Assurance/Laboratory Contract Program.

ARAR - Applicable or Relevant and Appropriate Requirement.

ASTM - American Society for Testing and Materials.

ATSDR - Agency for Toxic Substances and Disease Registry.

BCF - Bioconcentration Factor.

BLS - Below Land Surface.

BNA - Base, Neutral and Acid Extractable Organic Compounds.

BSAP - Basic Sampling and Analysis Plan.

CAA - Clean Air Act.

CCS - Contract Compliance Screening.

CEC - Cation Exchange Capacity.

CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act.

CFR - Code of Federal Regulations.

CLP - Contract Laboratory Program.

CNO - Chief of Naval Operations.

COC - Chain-of-Custody.

CR - Complex Resistivity.

CRAVE - Carcinogen Risk Assessment Verification Endeavor.

CROL - Contract Required Quantitation Limit.

CSRS - Confirmation Study Ranking System.

CWA - Clean Water Act.

DGP - Data Gathering Plan.

DMP - Data Management Plan.

DOD - Department of Defense.

DQO - Data Quality Objectives.

DQCR - Data Quality Control Report.

DRMO - Defense Reutilization and Marketing Office.

DVRS - Data Validation Report Sheets.

ECAO - Environmental Criteria and Assessment Office.

EEM - Environmental Evaluation Manual.

EIS - Environmental Impact Study.

ELCR - Excess Lifetime Cancer Risk.

EM - Electromagnetic.

EPA - Environmental Protection Agency.

ESI - Extended Site Inspection.

FDER - Florida Department of Environmental Regulation.

FAC - Florida Administrative Code.

FDVC - Field Data Validation Checklist.

FFA - Federal Facilities Agreement.

FID - Flame Ionization Detector.

FIFRA - Federal Insecticide, Fungicide and Rodenticide Act.

FS - Feasibility Study.

FSP - Field and Sampling Plan.

FWQC - Federal Water Quality Criteria.

GPR - Ground Penetrating Radar.

HA - Health Advisory.

HASP - Health and Safety Plan.

HEAST - Health Effects Assessment Summary Table.

HI - Hazard Index.

HQ - Hazard Quotient.

HRS - Hazard Ranking System.

IAS - Initial Assessment Study.

IDW - Investigation-Derived Wastes

IR - Installation Restoration.

IRIS - Integrated Risk Information System.

IRP - Installation Restoration Program.

LDP - Laboratory Data Package.

LL - Liquid Limit.

LOAEL - Lowest Observed Adverse Effect Level.

LOQ - Limit of Quantitation.

LTO - Laboratory Task Order.

MCL - Maximum Contaminant Level.

MCLG - Maximum Contaminant Level Goal.

MDL - Method Detection Limit.

MF - Modifying Factor.

MPR - Monthly Progress Report.

MSL - Master Sample List.

NAAQS - National Ambient Air Quality Standards.

NACIP - Naval Assessment and Control of Installation Pollutants.

NADEP - Naval Aviation Depot.

NAS - Naval Air Station.

NAT - Navy Aviation Trade.

NCP - National Oil and Hazardous Substances Contingency Plan.

NEESA - Naval Energy and Environmental Support Activity.

NOAA - National Oceanographic and Atmospheric Administration.

NOAEL - No Observed Adverse Effect Level.

NOEL - No Observed Effect Level.

NPDES - National Pollutant Discharge Elimination System.

NPL - National Priority List.

NRMC - Naval Regional Medical Center.

NTGS - National Technical Guidance Series.

O&M - Operation and Maintenance.

OSWER - Office of Solid Waste and Emergency Response.

OTA - Office of Technology Assessment.

OU - Operable Unit.

OVA - Organic Vapor Analyzer.

PA - Preliminary Assessment.

PCBs - Polychlorinated Biphenyls.

PI - Plasticity Index.

PID - Photoionization Detector.

PL - Plastic limit.

POL - Petroleum, Oil and Lubricant.

POL - Practical Quantitation Limit.

PSC - Potential Source(s) of Contamination.

PVC - Polyvinylchloride.

PWO - Public Works Officer.

QA - Quality Assurance.

QAO - Quality Assurance Officer.

QAPP - Quality Assurance Program Plan.

QAPjP - Quality Assurance Project Plan.

QC - Quality Control.

QCS - Quality Control Summary.

QCSR - Quality Control Summary Report.

RASO - Radiological Affairs Support Office.

RCRA - Resource Conservation and Recovery Act.

RfD - Reference Dose.

RI - Remedial Investigation.

RME - Reasonable Maximum Exposure.

ROD - Record of Decision.

RPD - Relative Percent Difference.

SARA - Superfund Amendments and Reauthorization Act of 1986.

SAS - Special Analytical Services.

SCBA - Self Contained Breathing Apparatus.

SDWA - Safe Drinking Water Act.

SEAM - Superfund Exposure Assessment Manual.

SI - Site Inspection.

SIP - Spectral Induced Polarization.

SMP - Site Management Plan.

SP - Spontaneous Potential.

SQL - Sample Quantitation Limit.

SSHO - Site Safety and Health Officer.

SSHS - OU-Specific Safety and Health Supervisor.

TAG - Technical Assistance Grant.

TBC - To Be Considered.

TCE - Trichloroethene.

TCLP - Toxicity Characteristic Leaching Procedure.

TEM - Transient Electromagnetics.

TIC - Tentatively Identified Compounds.

TOC - Total Organic Carbon.

TRC - Technical Review Committee.

TSCA - Toxic Substances Control Act.

UF - Uncertainty Factor.

USACE - U.S. Army Corps of Engineers

USCS - Unified Soil Classification System.

USDA - United States Department of Agriculture.

USGS - United States Geological Survey.

VOA - Volatile Organic Aromatic.

VOC - Volatile Organic Compound.

EXECUTIVE SUMMARY

This is the Basic Site Work Plan for the Naval Air Station in Jacksonville, Florida (Site). The plan documents procedures to be utilized for CERCLA investigations of various potential sources of contamination (PSCs) identified at the Site. Also, the plan outlines methods for evaluating exposure pathways and health risks associated with contamination that may be present, establishes applicable or relevant and appropriate requirements (ARARs), and proposes procedures for screening and selecting any remedial actions that may be necessary.

The Basic Site Work Plan includes quality assurance documents that have been prepared and included as appendices, which describe the procedures and protocols necessary for sample collection, sample analysis, and data validation. Included are checklists to be used for documenting the decision process and compliance with data quality objectives and ARARs.

This Basic Site Work Plan will be used as the foundation for OU-specific RI/FS work plans prepared for selected PSCs. The Basic Site Work Plan comprehensively applies to all CERCLA work conducted at the Site; the OU-specific plans will precisely document field tasks for PSC characterization, including sampling locations, matrices, and analytical parameters; potential exposure pathways; concentration limits for constituents of concern; and classifications of potential remedial actions, if necessary.

1.0 INTRODUCTION

The Navy prepared this Basic Site Work Plan for the Naval Air Station Jacksonville, referred to as the "Site." The basic purpose of the Installation Restoration Program (IRP) is to characterize the nature and extent of risks posed by uncontrolled hazardous waste sites and to evaluate the potential remedial options. This Basic Site Work Plan was prepared in accordance with the Scoping of the IRP, the initial planning phase of the process. Activities of the Scoping phase include:

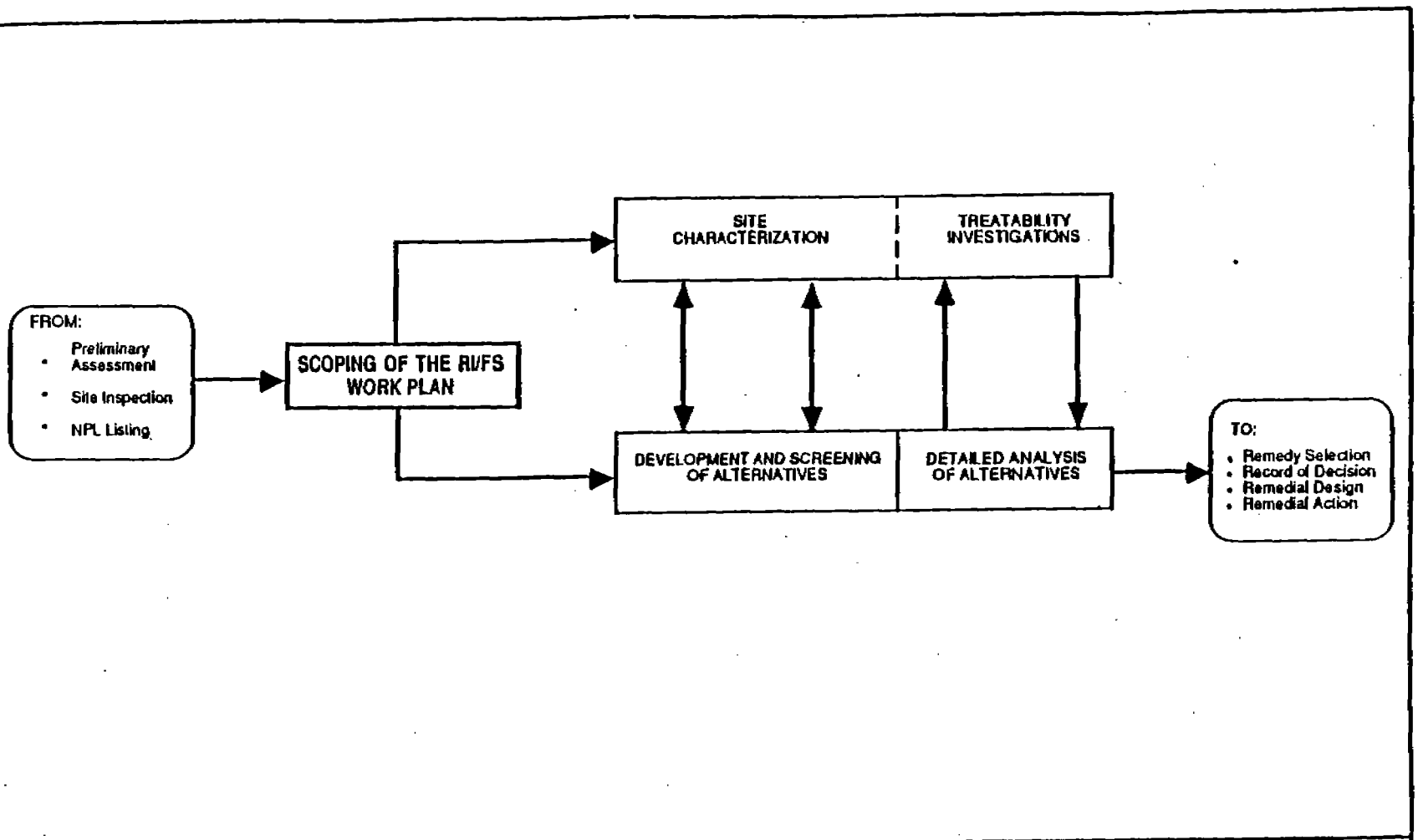
- the compilation and analysis of existing data;
- the initial identification of potential sources of contamination (PSCs) and operable units (OUs), likely response scenarios, and preliminary remedial action objectives and alternatives;
- the preliminary identification of ARARs;
- the identification of initial data quality objectives; and
- the preparation of investigative tasks.

The Basic Site Work Plan and appendices detail the tasks and field investigations to be used for the IRP activities at the identified PSCs. IRP activities may include Remedial Investigation/Feasibility Study (RI/FS) tasks, PSC screening activities, or the development of no further action justification. Included in the Basic Site Work Plan is a Basic Sampling and Analysis Plan (BSAP) consisting of a Quality Assurance Program Plan (QAPP) and a Basic Field Sampling Plan (BFSP). The Navy intends this report to apply to all subsequent IRP activities for the Site.

2.0 SCOPING

Initial scoping evaluations (Figure 2-1) are especially useful in delineating preliminary data quality and remedial action objectives for the PSCs. The EPA Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA discusses the initial evaluation precess used during scoping of an RI/FS. These initial evaluation steps include: (1) collecting and evaluating the existing data to determine the types and volumes of waste present; (2) identifying potential pathways of contaminant migration and preliminary public health and environmental impacts; (3) identifying preliminary PSCs and OUs, and (4) identifying preliminary response objectives and remedial action alternatives.

Scoping is performed prior to defining RI/FS work plan tasks for specific PSCs and OUs at the Site. Preliminary response objectives and remedial action alternatives are identified, as a result of scoping, in the OU-Specific RI/FS Work Plans.



SCOPING OF THE
RI/FS WORK PLAN

FIGURE 2-1

REMEDIAL INVESTIGATION/
FEASIBILITY STUDY
WORK AND PROJECT
MANAGEMENT PLAN
NAS JACKSONVILLE
SEPTEMBER 1991

3.0 INVESTIGATIVE FIELD TASKS

3.1 Waste Characterization Investigation

Waste characterization involves collecting data that describe the physical and chemical properties of waste materials and the matrices in which they are contained. These data are valuable for identifying indicator parameters, possible migration pathways, and monitoring procedures, as well as determining the nature and scope of remedial measures that may be applied.

The Navy may implement the Waste Characterization Plan whenever it is necessary to identify the types of waste disposed at each PSC. In contrast, the Navy may limit waste characterization when the PSC of concern is no longer active and the waste cannot be sampled.

The Waste Characterization Plan presents the appropriate methods used for (1) collecting data through review of available information, (2) collecting additional information, and (3) characterizing the physical and chemical properties of the materials. Section 3.1.1 and 3.1.2 discuss a two-tier approach to waste characterization. The tasks described in these sections represent the minimum effort implemented for waste characterization.

3.1.1 Review of Existing Data and Records

The examination of existing records identifies the types of waste materials detected and indicates constituents of concern that may be present at a PSC. These records may include but will not be limited to the following:

- waste characterization data used for permit applications,
- facility records of past waste analyses used for shipping manifests or any other purposes,
- past federal, state or local compliance and inspection results,
- records of disposal practices and operating procedures,
- facility health and safety monitoring data,
- reports on environmental assessments,
- information from waste haulers or generators,
- information concerning age and period of operation of facility, and
- information from past or present employees.

3.1.2 PSC Inspections

The Navy will conduct PSC inspections, as necessary, to generally define existing conditions. Information gained from a site inspection includes, but is not limited to the following:

- integrity of waste containment,
- location and size of areas of concern,
- location of drainage features and possible conduits for migration,

- locations of discharge points,
- level of site security, and
- facility map of all areas of concern.

3.1.3 Collection of Additional Information

In some cases, the Navy may adequately characterize the wastes by evaluating existing records or data on operating procedures. Where detailed, verifiable information on wastes at a PSC is not available, the Navy will conduct additional data collection activities.

3.1.3.1 Topographic Surveys. The Navy will conduct topographic surveys to obtain accurate PSC maps to assist in characterizing the areas of interest. If possible, the survey maps may be compared to historical survey maps or areal photography to determine changes in processes or disposal locations over time. This information can facilitate the selection of appropriate sampling locations.

3.1.3.2 Geophysical Surveys and Areal Photography. Where applicable, the Navy will use geophysical methods to determine the location and extent of buried waste deposits. The magnetic, resistivity, radar, and electromagnetic methods are described in the Hydrogeologic Investigation Plan (Section 3.2.2.4).

The Navy may also use areal photography and infrared imagery to aid in defining sources and impacted areas. Areal photographs of the facility and selected PSCs are available at the Site.

3.1.3.3 Sampling. The extent and location of sampling required for waste characterization will be determined by a

professional evaluation of additional information requirements. The extent of information gathered during the review of available data and PSC inspection, as well as the complexity of the PSC and environmental media, will be factors in determining the extent and locations of sampling.

The type of material being sampled and the setting from which the sample is collected dictate the sampling methods used. Waste materials may include solids, sludges, and liquids; settings may include drums, sludge drying beds, and surface impoundments. Table 3-1 provides a summary of sampling methods to be employed. Section 4.10 of the BFSP (Appendix 4.4.2) presents detailed descriptions of the sampling procedures.

The Navy will choose analytical parameters based on the extent of available information. Analyzing for broad indicator parameters, such as total organic halogens or pH, may be useful when the materials that may be present are unknown. Whenever possible, the Navy will conduct analyses for specific constituents of concern. Analyses may be performed by a laboratory or in the field when appropriate.

3.1.4 Chemical and Physical Characterization

The Navy will conduct compound-specific characterization whenever possible. The Navy will analyze only those constituents believed to be present in the waste. Also, analysis of samples in the field will be conducted whenever appropriate.

The Navy will perform analyses for a broad category of constituents when little or no information is available concerning the types of waste materials that may be present at the PSC. Broad categories of constituents may include such parameters as total

Table 3-1. Summary of Sampling Methods for Waste Characterization

Waste Type	Scoops and Shovel	Thiefs	Augers	Core Samplers	Glass Tubes	Dippers	Pump and Tubing	Kemmerer Bottle
Solids								
Waste Piles	X	X	X					
Land Treatment Units	X			X				
Landfills			X	X				
Drum Handling	X	X						
Sacks and Bags	X	X						
Trucks	X	X		X				
Conveyor Belts	X							
Unloading/Loading/ Transfer Areas	X			X				
Sludges								
Waste Piles	X			X				
Drum Handling	X			X	X			
Tanks	X					X		
Surface Impoundments	X					X		
Trucks	X			X		X		
Conveyor Belts	X							
Unloading/Loading/ Transfer Areas				X	X	X		

Table 3-1. continued

Waste Type	Scoops and Shovel	Thiefs	Augers	Core Samplers	Glass Tubes	Dippers	Pump and Tubing	Kemmerer Bottle
Liquids								
Drum Handling					X	X	X	
Tanks							X	X
Surface Impoundments						X	X	X
Surface Disposal Areas	X		X	X				
Trucks						X	X	X
Unloading/Loading/ Transfer Areas						X	X	

organic halogens, pH, the Contract Laboratory List of constituents, or Appendix IX list of constituents (40 CFR, Part 264).

Table 1-1 of the QAPP (Appendix 4.4.1) lists appropriate analytical methods for identification of selected constituents and chemical characterization of waste. The Navy will gather additional chemical information from review of the selected reference books listed in Table 3-2.

The Navy will reference computerized data bases such as the Chemical Information Service to identify the physical characteristics of the identified waste constituents. Physical parameters of interest may include corrosivity, flammability, specific gravity, boiling point, degradability, and compatibility with other types of waste.

3.2 Hydrogeologic and Soil Investigation Plan

The objective of the hydrogeologic investigation plan is to provide an outline for conducting the investigations needed to (1) determine the nature of the subsurface geology and aquifer characteristics at the PSC, (2) determine the presence or absence of contamination, and (3) the horizontal and vertical extent and migration potential of the ground-water plume, if present. The steps involved in conducting a hydrogeologic investigation include (1) a review of existing regional and PSC-specific hydrogeologic data and reports, (2) a review of the operation history at the PSC, (3) an evaluation of data needs, and (4) performance of field investigations to collect PSC-specific data in order to achieve the objectives.

Table 3-2. References for Determining Physical and Chemical Characteristics of Waste

Callahan et al. 1979. Water-Related Environmental Fate of 129 Priority Pollutants, Volumes I and II. Office of Water Planning and Standards. NTIS PB 297606. Washington, D.C. 20460.

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Mabey, et al. 1982. Aquatic Fate Process Data for Organic Priority Pollutants. Prepared by SRI International, EPA Contract Nos. 68-01-3867 and 68-03-2981. Prepared for Office of Water Regulations and Standards. Washington, D.C. 20460.

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Table 3-2. continued

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3.2.1 Survey of Existing Hydrogeologic Data and Reports

The available literature on the PSC hydrogeology is reviewed before PSC-specific field investigations are conducted. In order to characterize the local hydrogeological parameters at the PSC, it is necessary to examine and analyze the regional hydrologic framework. Much of the regional hydrogeologic data, including recharge/discharge areas, regional pumpage effects, regional ground-water flow directions, regional water-quality trends, and hydraulic characteristics of the aquifer(s), are available through published reports and data generated by federal, state, and local agencies. These types of reports include U.S. Geological Survey water-supply and professional papers, Water Management District professional publications, Soil Conservation publications, and State reports. The Navy will also review existing hydrogeologic data and reports generated during earlier PSC-specific investigations. The Navy will also review available historical data and aerial photographs.

3.2.2 Field Reconnaissance Activities

The Navy may conduct several reconnaissance activities to provide an overall assessment of the site. Reconnaissance activities included soil gas sampling, surface geophysical surveys, recording water levels and collecting samples from existing monitor well at the PSC.

3.2.2.1 Water Well and Spring Survey. The Navy will conduct water well inventory to determine the existence and location of water wells, flowing wells, or springs, which are used or have the potential for use by humans or livestock or wildlife, on or within one mile downgradient and cross-gradient and one-half mile upgradient of the PSC. The Navy will review water well records and/or conduct a house-to-house inventory. Whenever possible, the

Navy will determine well location, depth, screened interval, grouted interval, well head protection, water use, owner, driller, and number of people served. The purpose of the water well inventory is to locate existing wells that may potentially be used for monitor wells and to determine the existence of potential receptors.

3.2.2.2 Sampling Existing Wells. The Navy may use existing monitor wells as well as private wells for monitoring on a limited basis. The Navy must obtain and evaluate well construction information pertaining to each well to determine if the well is properly constructed and grouted and if it is screened in the zone(s) of interest. The Navy can measure water levels and collect samples for chemical analyses from a properly constructed well. Such wells may be used for aquifer testing as well. The Navy may also obtain regional, or background, water level and water-quality data concerning private water wells or monitor wells located offsite.

3.2.2.3 Soil-Gas Sampling. Concentrations of soil gas may indicate the presence of volatile organic constituents in the saturated or unsaturated soil below the sampling locations. The purpose of subsurface soil-gas sampling is two-fold:

- To identify source areas and characterize the nature and extent of migration of gaseous constituents associated with soil contamination, and
- To detect the release of gases associated with ground-water contamination for the purpose of identifying the lateral extent and boundaries of ground-water contamination.

The Navy will measure the concentrations of soil gas by headspace in soil cores, or boreholes or by using the driven probes method. Headspace measurements of soil cores or boreholes are useful to determine hydrocarbon concentrations. The Navy will collect samples by auger or similar method and measure the headspace in the half-filled container. The driven probes method uses a drive tip that is driven into the ground and attached to the probe and tube leading to the surface. Openings in the probe tip allow gases to be pumped to the surface.

Soil gas samples may also be collected from shallow boreholes (6 to 10 ft bls) using a bar punch. The bar punch is a steel bar, which is either hammered or driven into the ground. After the bar punch is pulled out, Teflon tubing is inserted to the bottom of the borehole. The annular space between the Teflon tubing and the borehole is closed with an impervious seal. A sampling pump is then attached to the tubing and the hole is evacuated of air-diluted gases. Methane gas measurements and organic vapor measurements may now be made using an explosimeter and an organic vapor analyzer-flame ionization detector (OVA FID), respectively. Samples for specific constituents may be collected in Tedlar bags for analysis by a portable gas chromatograph equipped with one or more of a variety of common detectors.

3.2.2.4 Surface Geophysical Methods. Surface geophysical methods provide information on the structure and stratigraphy of the local geologic environment and aquifer properties, as well as locations of contaminant plumes, trenches, and buried drums. Surface geophysical methods provide information on subsurface conditions and geology, which can guide the placement of test pits, monitor wells, exploratory drilling, or sampling locations. Surveys can be performed to detect buried metallic objects, conductive plumes, depth to bedrock, depth to the water table, depth to confining layers, and ground-water resource location.

These surveys are part of the initial investigations for remedial action planning. Subsequent surveys may be used to monitor corrective action operations. Additionally, contractors often consult such surveys at hazardous waste site, as a safety precaution, to avoid digging or drilling through "hot spot" areas that may contain hazardous waste, buried drums, buried gas pipelines, underground storage tanks, or subsurface telephone and power cables.

Surface geophysical methods include electromagnetic surveys, magnetic surveys, and resistivity surveys.

Electromagnetic Surveys: The term electromagnetic refers to geophysical methods which use ground penetrating radar and metal detectors to measure subsurface conductivities by low frequency electromagnetic induction.

Electromagnetic (EM) or ground conductivity methods measure the electrical conductivity of subsurface soil, rock, and ground water. Electrical conductivity is a function of the type of soil and rock, its porosity, permeability, and the fluids which fill the pore space. EM methods are applied to assess natural hydrogeologic conditions and to map ground-water plumes. In addition, the Navy may locate buried drums and conductive waste, trench boundaries, and metallic objects using these techniques. A typical instrument used for electromagnetic surveys is an EM31. This instrument has transmitter and receiver coils. The transmitter coil is used to induce currents into the ground using 9.6 kilohertz (Khz) signals. The receiver coil measures the magnetic field resulting from the induced currents in the ground. The measured electromagnetic field can be either in-phase with the primary signal at the transmitter coil or out-of-phase. In-phase readings will be used to detect buried metals. The out-of-phase signal will be used to measure the conductivity of the ground. The orientation of the coils may be

changed such that their plane lies parallel (vertical dipole mode), or perpendicular (horizontal dipole mode), to the ground surface. The vertical dipole mode with the EM31 has an effective exploration depth of about 20 feet. The horizontal dipole mode has an effective exploration depth of about 10 feet. The two modes can be used to assist in reducing the influence of near surface resistivity changes on the deeper data. Readings are typically taken along lines with station spacings of approximately 10 to 20 feet. Electromagnetic surveys provide quality reconnaissance data for PSCs because they permit rapid data collection. However, depth to target, subsurface resistivity, and noise considerations must be evaluated beforehand, to optimize these types of surveys.

Magnetic Surveys: Magnetic measurements are used to map geologic structure and minerals and to locate pipes, buried drums and trenches. Magnetometers measure the intensity of the earth's magnetic field. The amount of ferrous material, either man-made or naturally occurring, creates variations in the local strength of the earth's magnetic field.

Contractors frequently use magnetic methods if the electromagnetic methods are unable to detect the metal targets, which may be the object of a particular survey. If the ground is conductive, the penetration of the electromagnetic waves may be limited and deeper metal objects may be missed. The magnetic method uses a magnetometer to measure the magnetic field strength about 6 feet above the ground surface. Buried metal objects influence the magnetic field for some distance surrounding the object, creating an anomalous magnetic field. The Navy can observe this field using a magnetometer. In addition, the Navy will measure the vertical gradient of the magnetic field using a gradiometer, resulting in the simultaneous collection of gradient and total field magnetic data. This produces a data set that is more sensitive to near-surface buried metal, and is useful in

pinpointing the location of the buried metal. Total field magnetic data can help determine an order of magnitude depth estimate to the source of the anomaly, and the vertical magnetic gradient data provides near surface information. In addition, the gradient data provides confirming evidence to the total field data since the diurnal drift of the earth's magnetic field is automatically removed.

During a magnetometer/gradiometer survey, the surveyor takes readings along lines at stations spaced approximately 10 to 20 feet apart. The actual spacing used depends on the target size and depth. In addition, the surveyor will establish a base station, where readings will be taken approximately every hour. These readings will allow for the removal of drift in the natural magnetic field from the field data. To ascertain that no high-frequency natural magnetic field oscillations are present, the operation periodically remains stationary at one location and observes the magnetic field data. If no significant changes are occurring, then the survey continues. If significant changes occur, then the surveyor monitors the base station more frequently. Large changes may indicate that a magnetic storm is in progress and the survey may be stopped until normal conditions return.

Resistivity Surveys: Remedial Contractors use resistivity methods to measure the electrical resistivity of the hydrogeologic section, including the rock, soil and ground water. The Navy may also use this method to evaluate contaminant plumes and locate buried wastes. Other applications include locating trenches, defining trench boundaries, and determining the depths of trenches.

Spectral Induced Polarization (SIP) or Complex Resistivity (CR), measures the resistivity of the ground at numerous frequencies. Such measurements evaluate the polarizability of the ground. Scientists have reported changes in the natural

polarizability of clays due to hydrocarbon contamination. It can also change as the salinity of the water in the pores of the rock changes. Polarizability increases dramatically in the presence of naturally occurring sulfides or in the presence of buried metallic objects.

3.2.3 Hydrogeologic Field Investigations

Based on the review of existing data and reports and the results of field reconnaissance activities, the Navy will undertake a field investigation program to collect information on the hydrogeology, including lithology, stratigraphy, structure, presence of aquifer(s) and confining unit(s), aquifer characteristics, physical and chemical characteristics of the soil, water levels, recharge/discharge, water-quality, and ground-water use.

3.2.3.1 Soil and Sediment Investigation Plan

Initially, the soil and sediment investigation plan will provide a framework for PSC-specific identification of the nature and extent of soil contamination at each PSC. For purposes of this discussion, soil is considered the material that exists in the unsaturated zone above the water table. The potential for inter-media transfer of releases from soil to other media is significant. Contaminated soil can serve as a source of contamination to ground water, air, subsurface gas, and surface water.

The investigation tasks will include a review of existing data and field studies that will help define the nature and magnitude of the existing contamination. Factors to be considered include physical and chemical properties of soil, subsurface geology and hydrology, and climatic or meteorologic patterns.

Soil and PSC maps aid in designing sampling procedures by identifying drainage patterns, areas of high or low surface permeability, and areas susceptible to wind erosion and contaminant volatilization. The field personnel may prepare maps of unconsolidated deposits from soil conservation maps, existing soil core information, well drilling logs, or from previous subsurface studies.

During the field investigation, the field personnel will note the depths of soil horizons, soil types and textures, and the presence of joints, channels, and zones containing plant roots or animal burrows. Field personnel will record physical characteristics of each distinct soil layer or boundary between layers that may be affected by a waste release. Soil and formation samples will be described in the field, and lithologic logs will be prepared using the Unified Soil Classification System (USCS). Determination of the range and variability of values for soil properties and parameters will allow more accurate prediction of the mobility of contaminants in the soil.

3.2.3.2 Field Sampling Program for Soil and Sediment

The objectives of soil sampling and characterization activities are to characterize the chemical quality of soils in order to determine the extent of soil contamination and to assess the potential for contaminant migration. The field personnel will conduct the soil sampling to verify suspected releases or to begin characterizing known releases. The characterization will require physical and chemical measurements of the soil and sediments.

The Navy and its contractors will prepare monitoring procedures that specify locations, numbers of samples, depths, collection techniques, and constituents to be analyzed for soil samples prior to each sampling effort. These procedures will

provide the justification for the proposed samples, in terms of their expected contribution to the investigation.

(a) Determination of Sampling Locations. Determination of the sampling locations will depend on the facility layout, topography, the distribution of surface soils, soil stratigraphy, and information on the nature and source of the release. The size and type of unit may affect the area under consideration.

Selection and sampling of appropriate background areas are important because verification of a release in a contaminated area may involve a comparison of study and background concentrations. High variability in the chemical composition of soils makes determination of background levels for the constituents of concern essential. This is particularly important for quantification of toxic metals, because such metals commonly occur naturally in soil. Background areas not affected by releases at a PSC should be selected based on their similarity to the study area in terms of soil type, drainage, and other physical factors. The field personnel will take background soil samples from areas that are not near a suspected source of contamination and from the same stratigraphic layer as the study area samples, if possible.

(b) Determination of Number of Samples. The field personnel will collect soil samples from the vicinity of known PSCs. The total number of samples necessary for the initial investigation will depend on the extent of prior information, the suspected potential areal extent and severity of the release, and the objectives of the characterization.

(c) Determination of Sampling Parameters. The Navy and its contractors will determine sampling parameters based on a review of existing soil laboratory analyses. Special attention will be focused on parameters that have been detected and confirmed

by multiple sampling events. The Navy and its contractors may choose sampling parameters based on a review of a history of the PSC and a determination of the wastes reportedly disposed of at the PSC. The Navy and its contractors will select sample parameters in accordance with the results of the Waste Characterization Plan, if implemented. The Navy and its contractors may also choose sampling parameters based on the results of field screening investigations.

3.2.3.3 Reconnaissance and Field Screening Methods. The Navy and its contractors may use field screening, or reconnaissance methods, in some cases to aid in the identification of the areas of concern, including general areas of disposal, areas of contamination, and contaminant constituents of concern. Initial characterization efforts may utilize rapid, field-screening methods, such as soil gas surveys and/or shallow sampling and field analyses to establish the extent of the study area. The field personnel can detect volatile compounds near the soil surface using rapid, field screening methods such as portable PID (HNu or Photovac) or an organic vapor analyzer (OVA). The field personnel can also detect and measure organic vapors in shallow boreholes or in ground-water monitoring wells. Vapor sampling is useful for initial characterization, because it is a rapid and semi-quantitative technique. Surface geophysical techniques can sometimes identify subsurface soil contamination.

3.2.3.4 Sample Collection for Laboratory Geotechnical and Chemical Analyses. Appropriate sample collection and preservation techniques are specified in Section 4.7 of the BFSP (Appendix 4.4.2). The field personnel will follow specific procedures to store and preserve samples to minimize their degradation. The sampling techniques described herein are commonly used with a minimum of soil disturbance. Soil sampling methods will commonly vary with the depth of interest. The field personnel can accomplish surficial sampling in the upper 6 inches of soil usually

with simple tools, including metal shovels, spatulas, soil punches, and ring samplers. Constituents that have moved further downward in the soil profile often require tools such as steel tube samplers and augers. Manually operated tools are commonly useful to about 8 feet in depth, depending on the soil type. Below this depth, hydraulically or mechanically driven equipment generally is needed.

At each PSC, the field personnel will describe in the field the soil or sediment sample collected. The field personnel will describe the lithology, stratigraphy, color, texture, grain size, and visible staining. The field personnel will note other soil conditions, such as solution channels, secondary porosity, and expansive soils and clays. Where possible, the field personnel will note the depth to ground water and the thickness of the unsaturated zone, which may affect attenuation capacity of the soil and the time necessary for contaminants to migrate to ground water. The field personnel will note meteorological conditions, including wind and precipitation.

(a) Surficial Sampling Techniques. Surficial soils may also contain various materials, including rocks, vegetation, and man-made items. The field personnel will use care in choosing sampling equipment that will not adversely affect the analytical objectives (e.g., painted or chrome/nickel plated equipment may adversely affect metals analyses). Some commonly used surficial soil sampling techniques are discussed below.

Soil Punch: A soil punch is a thin-walled steel tube that is commonly 4 to 6 inches long and 0.5 inches to 2 inches in diameter. The tube is driven into the ground with a wooden mallet and twisted to free the sample. The punch is pulled out and the soil pushed or shaken from the tube. This technique is rapid, but generally is not useful in rocky areas or in loose, granular soils that will

not remain in the punch. Soil punching is not useful for soil structure descriptions because the method causes compaction that destroys natural fractures.

Ring Samplers: A ring sampler consists of a 6- to 12-inch-diameter steel ring that is driven into the ground. The soil is subsequently removed for analysis. This technique is useful when results are to be expressed on a unit area basis, because the soil ring contains a known area of soil. Ring samplers generally will not be useful in loose, sandy soils or stiff clays.

Shovels, Spatulas, and Scoops: The Navy and/or Contractor does not recommend collection of grab samples by shovel, spatula, or scoop if sample area or volume determinations are required. (The two previous methods are more accurate). The reproducibility of sample size is limited and subject to sample bias. The principal advantages of grab sampling are the efficiency of collection; more samples may be collected, thereby providing a better understanding of the range of contaminant concentrations at a PSC.

Tube Samplers: Tube samplers, which can be obtained in several diameters, are designed to obtain samples from the upper two meters of the soil profile. The tube sampler is commonly a stainless-steel or brass tube that is sharpened and beveled on one end and fitted with a T-handle. The Field personnel push the sampler into the soil in 8- to 12-inch increments. At the desired depth, the field personnel pulls the tube out and the soil sample extruded. The field personnel may consider the sample "disturbed" or "undisturbed" depending on whether it can be removed intact. However, the samples generally are considered to be disturbed for the purposes of engineering or physical measurements. Loose soils will be difficult to sample with this tool, and the borehole may tend to collapse when the tube is withdrawn to obtain samples.

Hand Augers: Hand augers collect soil in a 3-inch diameter cylindrical bucket and can be advanced to depth of up to 20 feet below land surface or several feet below the water table. While the augers provide disturbed samples, sufficient lithologic information can be obtained.

(b) Deep Sampling Techniques. The field personnel may take deeper soil samples in conjunction with drilling for monitor-well installation.

Hollow-Stem Augers: Hollow-stem augers have a continuous flight-cutting blade around a hollow metal cylinder. A stem with a plug is ordinarily kept inside the auger barrel to prevent soil from entering. When core samples are desired, the stem is withdrawn and a tube sampler or core sampler may be inserted to the bottom of the borehole. The field crew may use this drilling method for continuous soil sampling. An additional advantage of hollow-stem augers is that they do not require drilling fluids.

Solid-Stem Augers: Solid-stem augers, as the name implies, are augers that do not have an inner barrel. As with the manual variety, single-flight augers must be withdrawn each time a sample is desired, or samples may be taken from the cuttings brought to the surface by augers of the continuous flight type. The Field Crew may use augers in conjunction with tube samplers by withdrawing the auger and obtaining a sample from the bottom of the borehole. This sampling approach is only useful with soils that do not cave in or crumble after drilling.

Core Samplers: The field crew may use core samples to determine stratigraphy, for chemical and grain-size analysis, or for pore water extraction. The field crew may use hydraulically or mechanically-driven drilling rigs. The Field Crew will use thin-walled Shelby tubes and split-spoon samplers.

The Shelby tube is a metal cylinder with the end sharpened and beveled for cutting into the soil. Common sizes used for field investigation are 1 to 3 inches in diameter. The tube is pushed down into the soil by applying downward pressure from a drilling rig. Thin-walled tubes produce high quality undisturbed cores that can be used for engineering and hydraulics testing, but are useful only in cohesive soils because loose soils may fall out of the tube during removal. The soil must be extruded from the tube in a laboratory or in a field extruding unit because core removal is generally difficult. For rapid characterization of the soil stratigraphy in the field, split-spoon samplers are recommended.

Field personnel will conduct split-spoon sampling in accordance with ASTM-D 1586-84. A split-spoon consists of a hollow steel cylinder that can be divided in half. This assembly can be connected to drill rods. The tube is commonly forced into the soil by applying a 140-pound sliding hammer, dropping 30 inches along the drill rod (ASTM, 1986). The number of hammer blows required to advance the sampler in 6-inch increments is recorded. The total blow count number for the second and third increments is related to a standard engineering parameter indicating soil density. After the tube is pulled from the soil, the cylinder is removed from the drill rod and opened, exposing the soil core. Split-spoons are the preferred method for obtaining unconsolidated soil samples and may also be used to penetrate some types of rock.

3.2.3.5 Analyses of the Physical Properties of the Soil. Depending upon the physical and chemical properties of the waste and its constituents, contaminants of concern present may be bound to the soil or dissolved in the pore water; contaminants may occur as a vapor within the soil pores or interstitial spaces or as a distinct liquid phase. The investigation will take into consideration the predominant form of the contaminant in the soil.

The USCS is a procedure for qualitative field classification of soils according to ASTM D2487-85. The USCS is based on field determination of the percentages of gravel, sand and fines in the soil, and on the plasticity and compressibility of fine-grained soils.

The Navy and its contractors may conduct a variety of geotechnical analyses in the field or laboratory, including field infiltration tests and laboratory analyses of grain size, porosity, hydraulic conductivity, relative permeability, soil sorptive capacity, moisture content, and Atterberg Limits.

(a) Infiltration Tests (Infiltrometer method). The field personnel may use infiltration tests to determine permeabilities of sediment or unsaturated soils within the upper ten feet of land surface. Infiltration influences runoff and determines soil moisture. Tests identify the ability of the sediments to transmit fluids. Methods for determining infiltration rates include infiltrometers. Standard test method ASTM-D 3385-88 involves calculating the infiltration rate of soils in the field using a double ring infiltrometer.

(b) Grain-size Analyses. Grain-size analysis provides a means to examine the size and distribution of the grains. Grain-size distribution is determined by passing the disaggregated sample through a series of sieves. The Navy and its contractors plots the cumulative weight of the particles caught on each screen as a percent of the total sample weight against grain size. The plot indicates the degree of sorting and average grain size. Grain-size distribution will be analyzed in accordance with ASTM-D 421-85 and 422-63.

The grain-size distribution has two major uses in a soils investigation: (1) estimation of the hydraulic conductivity of the soil, and (2) assessment of soil sorptive capacity.

1. The hydraulic conductivity (K) may be estimated from the grain-size distribution using the Hazen formula:

$$K = A(d_{10})^2$$

where d_{10} is equal to the effective grain size, which is that grain-size diameter at which 10 percent by weight of the particles are finer and 90 percent are coarser (Freeze and Cherry, 1979). The coefficient A is equal to 1.0 when K is in units of cm/sec and d_{10} is in mm. Results should be verified with in-situ hydraulic conductivity techniques.

2. Particle size can affect sorptive capacity and, therefore, the potential for retardation of contaminants in the soil. Sandy soils generally have a low sorptive capacity whereas clays generally have a high affinity for heavy metals and some organic contaminants. The larger surface area of clays can result in stronger interactions with waste molecules. Clays may also bind contaminants due to the chemical structure of the clay matrix.

(c) Porosity. Soil porosity is the percentage of the total soil volume not occupied by solid particles (i.e., the volume of the voids). In general, the greater the porosity, the more readily fluids may flow through the soil. An exception is clayey soils that tightly hold fluids by capillary forces. The Navy and its contractors usually measure porosity by oven-drying an undisturbed sample and weighing it. It is then saturated with

[illegible] ease of performing this test will depend on the physical/chemical

liquid and weighed again. Finally, the saturated sample is immersed in the same liquid, and the weight of the displaced liquid is measured. Porosity is the weight of liquid required to saturate

properties of the contaminant and the availability of suitable analytical techniques to measure the chemical.

A second approach for determining K_d is to estimate the value from soil and waste properties. Soil properties that should be considered when using this approach are particle size distribution, cation exchange capacity, and soil organic carbon content. The waste properties that should be determined will vary depending on the type of waste.

Cation exchange capacity (CEC) represents the extent to which the clay and humic fractions of the soil will retain charged species such as metal ions. The CEC is an important factor in evaluating transport of lead, cadmium, and other toxic metals. Soils with a high CEC will retain correspondingly high levels of these inorganics. Although hazardous constituents may be immobilized by such soils in the short-term, such conditions do not rule out the possibility of future releases given certain conditions (e.g., action of additional releases of low pH). A method for the determination of CEC is detailed in SW-846, Method 9081 (U.S. EPA, 1986).

The amount of natural organic material in a soil also can have a strong effect on retention of organic pollutants. The greater the fraction by weight of organic carbon (F_{oc}), the greater the adsorption of organics. Soil F_{oc} ranges from under 2 percent for many subsurface soils to over 20 percent for a peat soil. An estimate of F_{oc} shall be based on literature values for similar soils if site-specific information is not available.

(g) Bulk/Clay Mineralogy. The presence of clay and other minerals may affect not only the fluid flow characteristics through the hydrogeologic unit but may also affect the rate and transport of contaminants. The Navy and its contractors may use

X-ray diffraction for determining bulk and clay mineralogy. Each mineral is composed of a unique unit cell which has its own signature as determined by an X-ray diffraction machine. X-ray diffraction techniques utilizes the minerals' unique signature to determine minerals and clays present. The Navy and its contractors may report values as relative percent of the total rock or sample.

(h) Moisture Content. Measurement of soil moisture content is important for two reasons: (1) active biodegradation generally does not occur in relatively dry soils, and (2) moisture content may be related to the relative strength of the soil. Moisture content is important when designing remediation systems and quantifying contaminant transport. The Navy and its contractors will conduct measurement of soil moisture content in the laboratory in accordance with ASTM-D 2216-80. Laboratory standard methods for determining moisture content are similar to that of porosity determination and involve weighing and heating of the sample.

(i) Atterberg Limit. Atterberg Limit tests (ASTM-D 423 and 424 and ASTM-D 4318-84) are conducted to determine the Plastic Limit (PL), Liquid Limit (LL), and Plasticity Index (PI) of fine-grained soils (i.e., soils containing more than 50% fines, soil passing the No. 200 Sieve). The PI and LL are used to classify the soil sample using the USCS as per ASTM Method D 2487-85. The value of the PI also determines the classification together with the LL of the sample.

3.2.3.6 Analyses of the Chemical Properties of the Soil. The field personnel may collect soil samples for laboratory chemical analyses. The methodology for preparation of samples and analytical techniques are described in the BSAP (Appendix 4.4).

The field personnel may conduct field analyses on soil samples, including determination of volatile organic vapors using either an OVA or an HNu or Photovac instrument. The OVA uses a FID to measure organic vapors. Any organic material that burns in a hydrogen flame can be detected. The OVA is most sensitive to aliphatic and aromatic hydrocarbons. It is less sensitive to alcohols, ketones, and aldehydes. The instrument's sensitivity decreases with increasing chlorine substitution to various hydrocarbons. The OVA is only moderately sensitive to many volatile organic halocarbons and is relatively insensitive to trihalomethanes and carbon tetrachloride.

The HNu and Photovac use a PID to detect selected organic vapors in the sampled air stream. These instruments primarily respond to organic compounds containing double or triple bonds such as alkenes (ethene, propene, etc.), chlorinated alkenes (trichloroethene, tetrachloroethene, various dichloroethenes), aromatic hydrocarbons (benzene, xylene, toluene), as well as many ketones and aldehydes.

3.2.4 Monitor Wells

The purpose of monitor wells will be to supplement existing wells in defining ground-water flow rates and direction, aquifer characteristics, and to assist in delineating the extent of ground-water contamination. Monitor wells will be installed in either the unconsolidated surficial sediments or the consolidated bedrock. Field personnel will decontaminate drilling development and sampling equipment in accordance with Section A.5.4 of Attachment A to the BFSP (Appendix 4.4.2).

3.2.4.1 Drilling. The selection of appropriate types of drilling is a function of the anticipated lithology. Drilling

methods considered for the site are hydraulic rotary, and hollow stem auger.

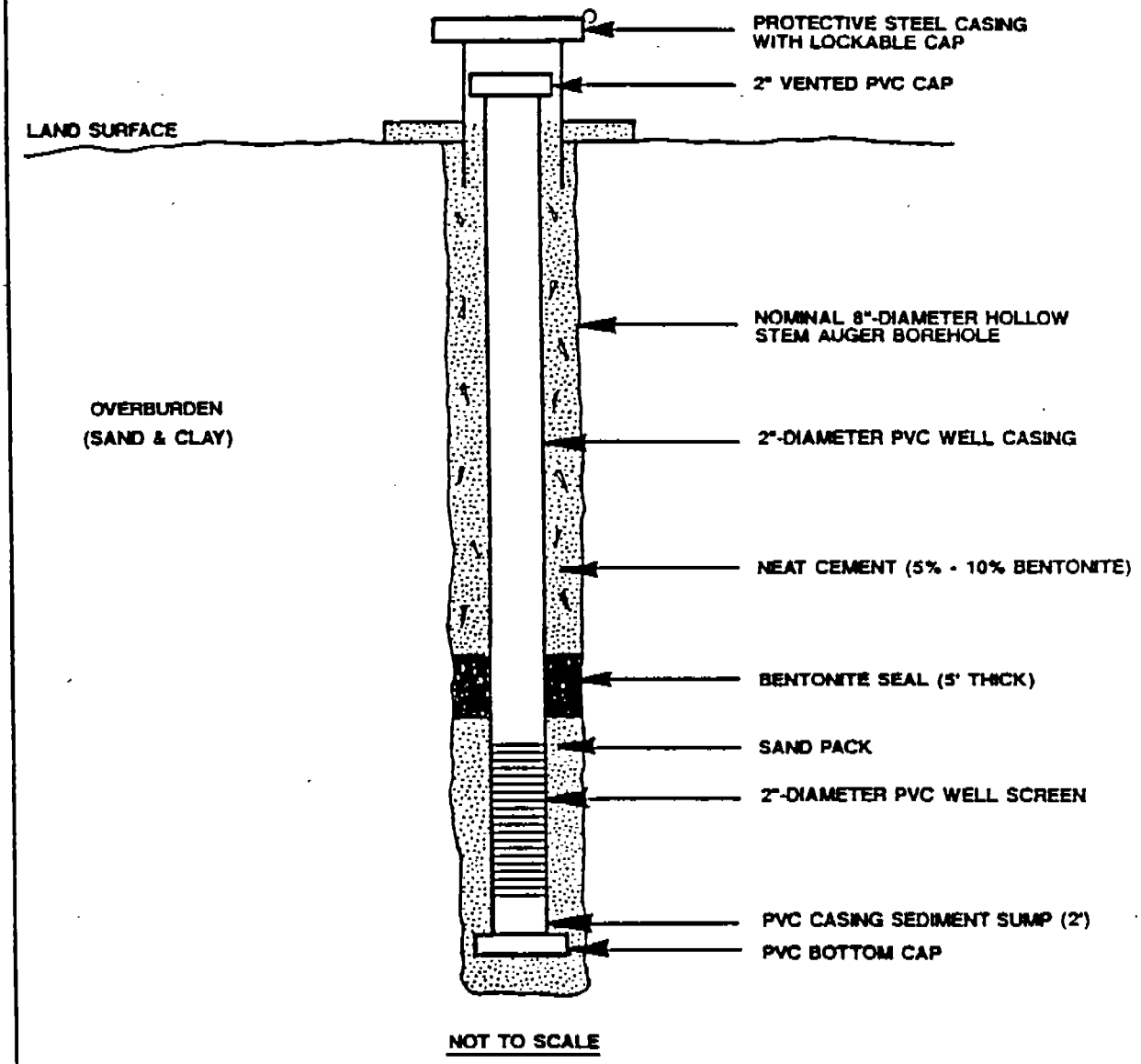
Hydraulic Rotary: Hydraulic rotary drilling involves drilling with a rotating bit. Soil and rock samples are removed by a recirculating drilling fluid consisting of a mixture of bentonite and/or natural mud and water. During mud-rotary drilling, a coating forms on the wall of the borehole sealing the borehole and preventing collapse. Formation samples, or drill cuttings, which are mixed and suspended in the drilling fluid move up the annular space of the borehole to land surface. Field personnel utilize the samples for describing the lithologies of the formations encountered, but not for obtaining chemical analyses due to the disturbance of the sample and the mix with drilling fluid and borehole sediments. However, upon removal of the drill stem, field personnel may use a split-spoon or Shelby tube sampler to obtain an undisturbed sample for geotechnical analyses. This method also utilizes large quantities of drilling fluid which may be a problem in contaminated conditions. However, depending on the purpose, rotary drilling is fast and may be cost effective when drilling below the surficial aquifer.

Hollow-stem Auger: Hollow-stem auger drilling involves the use of hollow auger flights to drill a borehole. The method is rapid and extremely effective in most unconsolidated, but cohesive sediments. The major advantage to this method is that fluids are not introduced to the hole. Also, it is the ideal method for drilling to obtain undisturbed samples for geotechnical and chemical analyses. The best method for collecting a soil sample using auger drilling is by driving a split spoon through the center of the auger flight. Maximum penetration using hollow stem auger is generally 75 to 100 feet below land surface.

3.2.4.2 Surficial Monitor Wells. The Navy and its contractors will drill boreholes for installation of surficial monitor wells by one of the described drilling methods. The borehole will be of sufficient diameter to permit a minimum of two inches of annular space when the well is installed. The field crew will complete the surficial monitor wells at varying depths depending on the lithology encountered; depths of surficial wells will be approximately 50 feet and less. The field personnel will collect (formation) split-spoon samples continuously to 10 feet below land surface (ft bls) and at 5-ft intervals thereafter to the total depth of the well where possible. Soil samples for grain-size distribution and moisture content will be collected with the split-spoon samplers. The field personnel will collect samples for Atterberg limits using a thin-walled sampling tube.

The field personnel will describe each sample's physical characteristic in detail on lithologic logs using the USCS. The field personnel will classify soil samples based on the results of geotechnical laboratory analyses as described in Section 3.2.3.5. and, the field personnel will prepare a detailed well construction log for each well (Figure 3-1).

The Navy and its contractors will construct monitor wells using 5 ft or more of new, 2-inch-diameter, factory slotted or continuous wrap, Type I, polyvinyl chloride (PVC) well screen with Schedule 40, threaded, flush joint, PVC casing extending to three ft above land surface. A schematic diagram of a typical surficial monitor well is shown in Figure 3-1. The PVC casings will conform to the requirements of ASTM-D 1785 and will carry the seal of the National Sanitation Foundation. The field crew may attach a minimum 2-ft section of closed-end, Schedule 40, PVC casing to the bottom of each screen to provide a sump for the collection of fine sediments that may accumulate in the well (Figure 3-1). The field crew will fit each well with a vented PVC cap.



TYPICAL SURFICIAL AQUIFER MONITOR WELL CONSTRUCTION DIAGRAM

FIGURE 3-1

REMEDIAL INVESTIGATION/ FEASIBILITY STUDY WORK AND PROJECT MANAGEMENT PLAN NAS JACKSONVILLE SEPTEMBER 1991

The Navy and its contractors will select the screen length, screen size, and screened interval of the well so that the completed monitor well yields quantities of water and samples that are representative of the selected zone of interest. The Navy and its contractors may perform a sieve analysis of one or more representative samples of the screened formation in accordance with ASTM-C 117 and C 136 if existing information is insufficient to select the appropriate screen size and sand pack.

The annular space between the borehole and screen will be filled with a uniformly graded silica sand (appropriately sized for the selected well screen) from the bottom of the hole to approximately 2 ft above the top of the well screen using the tremie method. The tremie method incorporates the use of a drop pipe placed in the annular space of the well through which sand can be placed at the desired depth.

The field crew will place a bentonite seal above the filter pack in each well to prevent downward migration of cement grout. The field crew will install the seal, consisting of tamped bentonite pellets or bentonite slurry, also by the tremie method. The bentonite seal will be allowed to hydrate for one hour. The field crew will seal the remaining annular space above the bentonite by pressure grouting with cement grout to land surface. The cement grout will consist of a mixture of Portland Type I cement (ASTM-C 150) and water in the proportion not to exceed seven gallons of clean water per bag of cement (94 pounds). Additionally, the field crew shall add 5 to 10 percent by weight of bentonite powder to the grout to prevent shrinking and to control the heat of hydration during grouting, which can cause the casing to warp.

The field crew will drill the boreholes as near to plumb and true as possible to assist in proper casing alignment, sand pack,

and cement seal. Centralizers will be used when necessary to assist in plumbness and alignment of the wells; centralizers will not be installed on the screened portion of any well.

The field crew will take care during the drilling and well construction to prevent the entry of foreign material into the well. Whenever the field crew is offsite (i.e., at night), the borehole/monitor well will be covered and secured to prevent vandalism. Upon completion of the well, the well casing will extend to 2 to 3 ft above grade and will be surrounded by a larger diameter steel casing set into a concrete pad. The steel casing will have a lockable cap. The concrete pad will be a minimum 3 ft x 3 ft x 4 inches, sloped away from the well. Four 2-inch or larger diameter steel posts will be equally spaced around the concrete pad and cemented into the ground to a depth of at least 3 ft bls.

After the completion of each monitor well, but no sooner than 48 hours after grouting is completed, the field crew will develop the wells by alternately swabbing (with a surge block) and pumping or bailing. The wells will be developed until pH, conductivity and temperature have stabilized. The field crew will not use acids, dispersing agents, or explosives in the well. Development will continue until it is determined that further development will not provide significant improvement of the turbidity. If the well yield is too low to permit continuous pumping or bailing, the well will be alternatively swabbed, pumped, or bailed dry, and allowed to recharge.

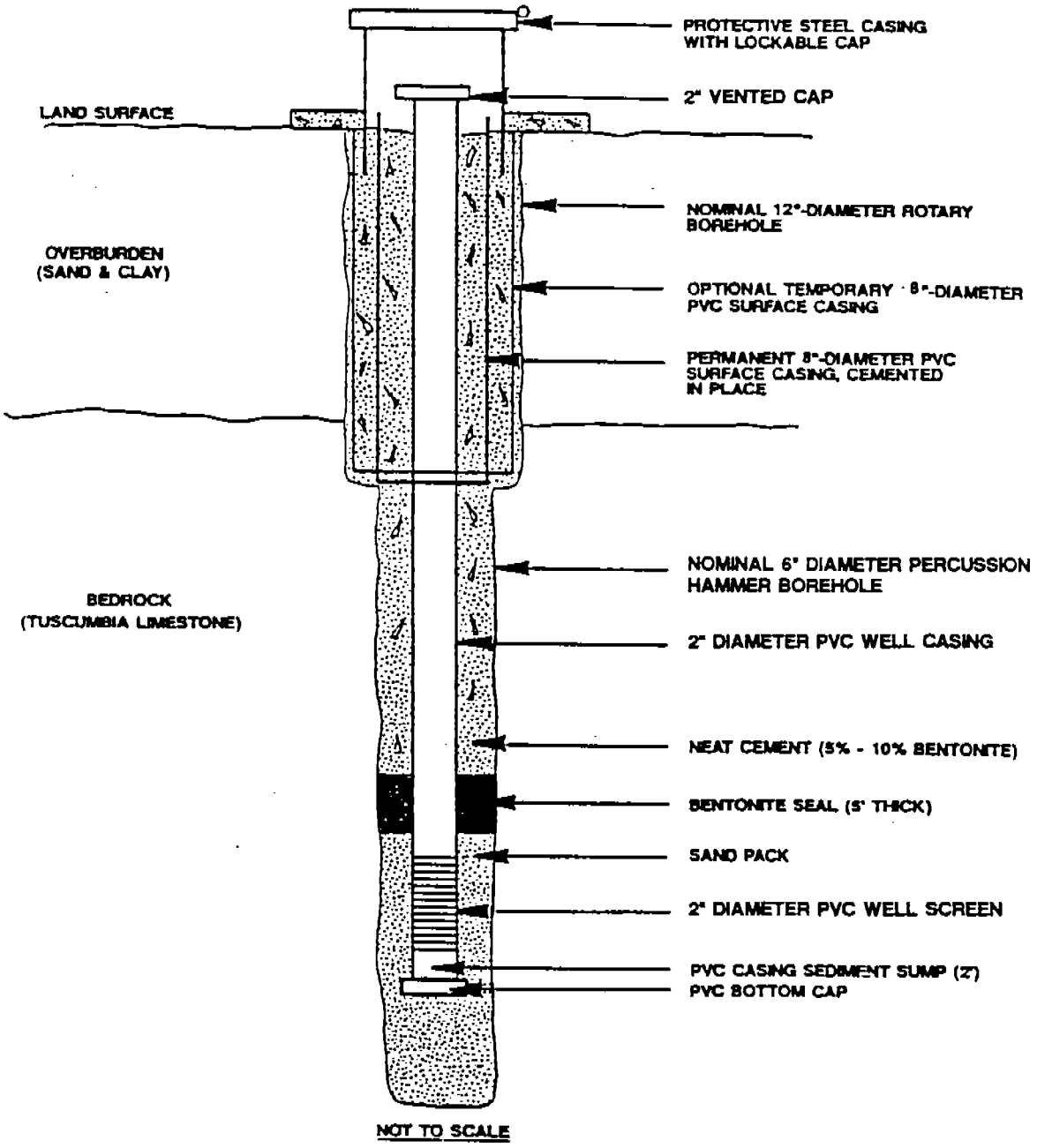
3.2.4.3 Monitor Wells with Surface Casings. The Navy and its contractor will drill boreholes for monitor wells requiring surface casings installation using the previously described drilling methods. The field crew will drill a pilot hole through the surficial sediments to the expected depth of surface casings

installation (estimated to be approximately 30 feet or less). The field crew will collect split-spoon formation samples, in the manner previously described, continuously from land surface to 10 ft bls and at 5 ft intervals thereafter until reaching the desired surface casing depth. The Navy and its contractors will store samples in labeled, air-tight plastic or glass containers. The field personnel will describe the physical characteristics of the samples obtained in detailed lithologic logs using the USCS. The Navy and its contractors will conduct geotechnical laboratory analyses as described previously.

After removal of the drill bit, the field crew will install a 10-inch diameter PVC surface casing to the total depth of the borehole. The field crew will then seal the annular space with cement grout by pressure grouting from the bottom of the hole to land surface. The grout used in these wells will meet the same specifications described for surficial monitor wells.

After allowing the surface casing grout to set for at least 24 hours, the field crew will drill a nominal 8-inch diameter borehole inside the surface casing by hydraulic rotary drilling. The field crew will use clean water as the circulating media during drilling to clear the borehole of cuttings. The field crew will complete the monitor wells at varying depths depending on the lithology and ground water encountered.

The Navy and its contractors will construct the monitor wells using 5 ft or more of new, 2-inch diameter, factory-slotted or continuous wrap, Type I, PVC well screen with Schedule 40, threaded, flush joint, PVC casing extending to three ft above land surface. Figure 3-2 shows a schematic diagram of a typical surface-cased monitor well. The PVC casings will conform to the requirements of ASTM-D 1785 and will carry the seal of the National Sanitation Foundation. The field crew may attach a minimum 2-ft



TYPICAL DEEP MONITOR WELL CONSTRUCTION DIAGRAM

FIGURE 3-2

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section of closed-end, Schedule 40 PVC casing to the bottom of each screen to provide a sump for sediments. The field crew will fit each well with a vented PVC cap.

The Navy and its contractors will select the screen length, screen size, and screened interval of the well so that completed monitor well yields quantities of water and samples that are representative of the selected zone of interest. The field crew will fill the annular space between the borehole and the screen with uniformly graded silica sand (appropriately sized for the selected well screen) from the bottom of the hole to approximately 2 ft above the well screen using the tremie method. The Navy and/or Contractor will complete the remaining well construction and preparation of drilling logs as previously described for shallow monitor wells.

3.2.4.4 Location and Elevation Survey. Location coordinates and elevations shall be established for each monitor well by a registered professional surveyor. Location coordinates and elevations for soil borings and soil/sediment sampling points will be surveyed by the field crew. The horizontal coordinates shall be to the closest 1.0 foot and referenced to the State Plane Coorindate System. Elevations to the closest 0.01 foot shall be established for the top of the casing (measuring point) at each monitor well, piezometer, and staff gauge. Elevations to the closest 0.1 foot shall be established on the ground surface for each boring and soil/sediment sampling site. These elevations shall be referenced to the National Geodetic Vertical Datum of 1929.

3.2.4.5 Aquifer Testing. The Navy and its contractors may design an aquifer test program to test the hydraulic characteristics of various aquifers beneath the PSC site. The Navy and its contractors will identify hydrologic parameters such as

storage coefficient, transmissivity, and leakage by aquifer testing. Hydraulic properties vary considerably from place to place depending on characteristics such as grain size, sorting, packing, cementation, stratigraphy, structure, and boundary conditions. These properties are reflected in values of transmissivity, storage coefficient, and hydraulic conductivity that indicates the ability of an aquifer to yield water to wells. Hydraulic properties will be calculated by aquifer testing.

(a) In Situ Permeability Tests. The Navy and its contractors may perform in situ permeability tests on monitor wells to determine the hydraulic conductivity of the formation around the screened portion of the wells. The field personnel perform the tests by rapidly lowering a closed end, water-filled PVC pipe (slug) into each well to displace the water column from its initial static level. The field personnel will monitor the water level in each well using a pressure transducer and portable data logger. The initial phase of the test is known as a falling head permeability.

After the water level equilibrates, the slug will quickly be removed causing the water column to instantly fall and then begin to rise toward its initial level, thereby initiating a rising head permeability. The Navy and its contractors will analyze the rising head data to determine the hydraulic conductivity at each well tested.

In situ permeability tests are useful in areas where disposal of large volumes of contaminated water accumulated during the longer duration tests, may pose a problem. Other benefits include speed and reduced cost. Drawbacks include relative inaccuracy and the limited amount of calculated hydraulic parameters.

(b) Specific Capacity Testing. Specific capacity testing involves the pumping of a well for a given time period (typically one to three hours) and measuring and recording the drawdown within the well. When the pump is turned off, the recovery of water levels in the well is measured and recorded. Specific capacity measures the rate of discharge of a well per unit drawdown. Analyses of the results of the specific capacity testing can provide information regarding the specific capacity of the well and well efficiency as well as some hydraulic properties of the aquifer, including hydraulic conductivity and transmissivity. In areas with contaminated ground water, disposal of the pumped water may pose a problem.

(c) Multiple Well Aquifer Pump Tests. Multiple well aquifer pump tests are similar in principle to single well tests. A well is pumped for a given time at a specific rate and water levels are measured in several wells at different distances and directions from the pumped well. The results of these tests provide the most useful and accurate information for determining hydraulic characteristics of the aquifers, including hydraulic conductivity, transmissivity, storage coefficient, specific yield, and leakance coefficient. The duration of these tests is typically 24 hours or longer. Significant quantities of water may be removed from the aquifer, the disposal of which may pose problems in areas of contaminated ground water.

3.2.4.6 Ground-Water Sampling Techniques. Various techniques are available to sample ground water, including ground-water probes, sampling from temporary well points, and sampling from monitor wells.

(a) Ground-water Probes. The Navy and its contractors may use driven probes to sample chemical constituents within the ground water. The field personnel can drive probes by hand or by

a geophysical rig to desired depths to collect discrete ground-water samples. A steel probe point is driven into the zone of interest, a small screen section is exposed for ground-water intake, the section is closed, and the sample is pulled to the surface. Subsequently, the Navy and its contractors can analyze the samples on site or in an analytical laboratory for the constituents of concern.

(b) Temporary Well Points. The Navy and its contractors can place temporary piezometers constructed of small diameter, slotted PVC well screen and casing, in hand augered soil borings in areas of shallow ground water. These temporary wells allow for a preliminary determination of ground-water flow direction and general water quality.

(c) Monitor Well Sampling. The field personnel will sample existing and proposed monitor wells according to the procedures specified in Sections 4.5 and 4.13.5 of the BFSP (Appendix 4.4.2). The sampling process typically includes obtaining field analyses, purging and sampling the well(s), and preparing, preserving, and shipping the sample(s) to the laboratory for specific analyses.

Water-Level Measurements: The field personnel will measure the static water level prior to purging and sampling the ground water. The field personnel will determine the static water level to the nearest 0.01 ft. The field personnel will use an electronic water-level indicator (M-scope) or chalked steel tape for the water-level measurement. The field personnel will record duplicate measurements for each well and will reference the measurement to the survey point (top of well casing). The field personnel shall calibrate devices used to measure ground-water levels to 0.01 ft per ten feet length. Before each use, the field personnel shall prepare these devices according to the manufacturer's instructions

(if appropriate) and checked for obvious damage. The field personnel shall decontaminate these devices after each use as described in Section A.5.1 of Attachment A to the BFSP (Appendix 4.4.2). The field personnel shall record all calibration and maintenance data in a logbook.

Purging the Well: After a water level measurement has been taken, the field personnel will purge the monitor well to remove the standing water. Purging can be accomplished by pumping or bailing. If pumping is used, the field personnel will position the end of the intake tube just below the static water level. The intake is then lowered as the water level drops so that the water in the well casing is completely and efficiently removed. The intake tube will be removed from the well before suction has been discontinued. Bailing the well is acceptable; however, if a bailer is employed, the field personnel will take extreme care in lowering the bailer into the well to avoid "surging" the water in the casing. The field personnel will evacuate three to five volumes of water from each well and/or until pH, conductivity and temperature have stabilized. This will ensure that a representative sample of formation water is collected.

Field Measurements: After purging the well, the field personnel will collect a water sample to obtain measurements of pH, temperature, and conductivity. Before obtaining these measurements, the field personnel shall properly calibrate the field instrumentation in accordance with Section 5.4 of the BFSP (Appendix 4.4.2).

Sample Collection: After obtaining the field measurements, the field personnel will sample the monitor well for the parameters of interest. The Navy and its contractors will obtain samples for organic analyses with a bottom-filling Teflon™ bailer. Samples for inorganic parameters will be collected with a Teflon™ bailer or

peristaltic sampling pump fitted with Teflon™ tubing. Samples for dissolved metals will be collected directly into appropriate sample bottles using an in-line 0.45 μm membrane filter connected to the outlet of the peristaltic pump as indicated in Attachment C of the BFSP (Appendix 4.4.2).

The field personnel will collect samples of the ground water present in the screened interval by lowering the pump intake or Teflon™ bailer, as appropriate, to a depth below land surface (bls) that is approximately equal to the depth to the center of the well screen. This procedure will ensure that the sample collected is representative of ground water at the depth of the screened interval.

Table 1-1 and Section 5.4 of QAPP (Appendix 4.4.1) specify sample containers, preservation techniques, and shipping procedures, respectively. Attachment A of the BFSP (Appendix 4.4.2) details decontamination procedures for the pumping and sampling equipment.

3.3 Surface Water Investigation Plan

The objective of the Surface Water Investigation Plan is to provide a framework for the classification of surface water and sediment and the identification of physical features. Once these considerations have been identified, the Navy and its contractors can select sampling locations for PSC characterization at selected PSCs.

3.3.1 Review of Existing Data and Reports

A review of reports and documents will provide information that is vital to the investigation. These reports will disclose what types of materials have been disposed at the site, and whether

there has been a documented release directly into surface waters located near a PSC or via ground-water flow. Information obtained through this literature survey and by implementing the waste characterization plan, if necessary, will assist in determining the physical and chemical constituents/parameters of concern for potentially impacted sediment and surface-water bodies. The review of existing data, maps, aerial photos, and reports should identify the location of surface-water bodies onsite, the types of surface water and sediment, the classification of water bodies, and some of the physical features of the surface-water bodies.

3.3.1.1 Locations and Types of Surface Waters. The Navy and its contractors will identify surface-water bodies at the Site and at each PSC using existing data such as aerial photos and site maps. Site visits will confirm their location. Types of surface-bodies that may exist at the facility and that may act as exposure pathways for constituents at selected PSCs include streams, rivers, manmade canals and ditches, lakes, impoundments, and basins.

Streams, Rivers, Canals, and Ditches: Ephemeral streams are those that only flow in response to local precipitation. The bottom of the stream is always above the water table. Therefore, constituents that may be present at a PSC may migrate as a result of runoff. Intermittent streams receive some seasonal ground-water discharge and runoff from precipitation, and thus both avenues of flow are possible. Time periods for sampling are limited to after major rain events, or in the case of intermittent streams, during the wet season.

Perennial: Perennial streams flow throughout the year in response to ground-water discharge and/or surface-water runoff. Perennial streams are continually either receiving ground-water discharge (a gaining stream) or recharging the ground water (a

losing stream). Sampling events for perennial streams are not limited to certain seasons or rain events.

Lakes and Impoundments: Lakes are natural, while impoundments are manmade. The water source for these bodies may either be surface water and/or ground water.

Wetlands: Wetlands are areas that are inundated or saturated by surface or ground water. Included are swamps, marshes, and bogs. Wetlands are recognized as one of the most sensitive areas to contamination. The presence of contaminants in wetlands can serve as a secondary source of contamination for downstream surface waters in times of flood.

3.3.1.2 Classification of Water Body. Water-quality classifications are arranged in order of the degree of protection required, with Class I water having generally the most stringent water-quality criteria and Class V the least. The Navy and its contractors will use these criteria when assessing the surface-water impacts at selected PSC and with the final development of ARARs.

3.3.1.3 Physical Features. The Navy and its contractors may identify some of the physical features of the surface-water bodies, such as flow quantity and water quality in existing data or state reports. The Navy and its contractors will obtain flow records for gauged streams and rivers from the United States Geological Survey, Water Resources Division (USGS, WRD) in Jacksonville, Florida. The Navy and its contractors will obtain surface water-quality data from either the USGS, the FDER, or the St. Johns River Water Management District. The Navy and its contractors will also assess previous reports for information pertaining to surface-water flow quantity and quality.

The Navy and its contractors will also compile historical meteorological data. Seasonal variations in temperature and precipitation impact both surface-water quality and quantity.

3.3.1.4 Surface-Water Use. The Navy and its contractors will determine surface water use in order to identify potential receptors and to assess the environmental impacts of site activities. Surface water use may be included in federal, state, or local records or previous environmental assessments. If necessary, interviews with local municipalities and/or a site visit to view the extent and use of surface-water bodies may be conducted.

3.3.2 Hydrologic Field Investigations

In order to fully characterize the surface-water bodies and potential for contamination to these waters, the Navy and its contractors may need to conduct field investigations. Such field studies would be designed to sample/monitor water quality, quantity, and flow.

3.3.2.1 Migration Potential. Understanding migration potential is important to PSC characterization and risk assessments. Migration is impacted by infiltration rates, the velocity and gradient of the surface-water body.

(a) Infiltration Rate. The rate of infiltration directly influences the migration potential for contaminants to surface waters. Soils having a high infiltration capacity decrease the potential for surface runoff. Conversely, areas with low infiltration capacities, such as paved surfaces maximize the potential for runoff. The Soil and Sediment Plan (Section 3.2.3.5) describes procedures for determining infiltration rates of soil.

(b) Gradient. The Navy and its contractors will establish the hydraulic gradient for each PSC. The topography creates the drainage gradient and impacts hydraulic gradients; flat topography produces a low gradient and hence a slow rate of flow, high topographic relief increases the gradient, and hence the rate of flow.

(c) Flow Rate. The rate of flow influences the migration potential for contaminants to downstream and off-site areas, stream gauging is commonly used in streams and creeks to determine stream-flow velocity. A common field stream gauging instrument is a current meter. A current meter consists of a pinwheel of stainless steel cups which are lowered into the stream or creek to a depth of 0.6 times the total depth. The number of rotations of the cups within a particular time interval is used to calculate the average velocity of the stream. The Navy and its contractors can use the velocity values, together with the hydraulic cross section to determine flow rates.

3.3.2.2 Surface-Water Quality.

(a) Selection and Identification of Sample Locations. Based on the available information compiled for the PSC, the Navy and its contractors will choose applicable surface-water and sediment sample locations. The Navy and its contractors will select sample locations at the inferred point of entry of surface water to the PSC, possibly near runoff/discharge locations within the PSC boundary, and locations downstream as far as necessary to determine the impact of constituents. Sampling locations in small, standing surface-water bodies and/or temporary basins will be located strategically so as to sufficiently determine potential impacts from constituents.

(b) Determination of Analytes. The Navy and its contractors will choose sample analytes at each PSC in accordance with the results of the historical information review, results of previous sample analyses, and/or results of waste characterization investigations.

(c) Sampling. Once surface-water bodies are located, the Navy and its contractors will evaluate the potential that a particular water body is, or has been, impacted by conditions at the PSC. This process involves the assessment of the migration potential of contaminants through or over media to the surface-water body located near the PSC. The Navy and its contractors will identify specific sampling locations in the OU-specific sampling and analysis plans prepared for PSC characterization at selected OUs. The field personnel will collect surface-water and sediment samples according to the methods described in Sections 4.6 and 4.8 of the BFSP (Appendix 4.4), respectively.

3.4 Air Sampling Plan

The Navy and its contractors will conduct air sampling programs when ambient air is suspected to contain chemical vapors at concentrations that pose a risk to public health and the environment. The Navy and its contractors may use air sampling programs to evaluate both baseline ambient air conditions and ambient air during remedial activities. The objectives of an air sampling program are to determine the quality (type) and quantity (concentration) of airborne chemicals that may be present. The Navy and its contractors use this data in exposure assessment equations to determine magnitude of human health and environmental risk.

3.4.1 Data Use

The purposes for conducting air sampling are as follows: (1) to understand potential health effects if a no-action remedial alternative is selected, (2) to assess the appropriateness or impact of other selected remedial actions, and (3) establish existing site conditions to select protective equipment for working at the PSC.

3.4.1.1 Assess Current Conditions (No Further Action Alternative). The Navy and its contractors can determine magnitude of human health and environmental risk for current and future conditions from data obtained from the air sampling program. The human health risks associated with a PSC under current conditions (or the no-action alternative) are particularly important because of their potential economic impact on the Site. The magnitude of human health risk under current conditions will determine whether remedial action will be required to lower human health risks to acceptable levels. If human health risks under current conditions are acceptable, then a lesser financial effort may be necessary to achieve acceptable human health risks and satisfy regulatory concerns.

The Navy and its contractors evaluate current conditions by calculating the human health risk associated with inhalation exposure. The Navy and its contractors derive the health risks from an equation that predicts the amount of chemical taken into the body according to a particular exposure scenario. The equation incorporates exposure conditions (frequency and duration of exposure, body weight, breathing rate, chemical concentration, etc.) to compute the health risk. Where possible, the exposure conditions should represent circumstances at the PSC rather than conditions in general.

3.4.1.2 Evaluate Health Risks of Selected Remedial Activities. Another use of air sampling data is to evaluate the magnitude of human health risk under exposure conditions created by remedial activities. In this phase of the investigation, the Navy and its contractors derive health risk calculations for each remedial alternative. The Navy and its contractors select remedial activities based on several criteria. These criteria are that the selected remedial activities: (1) lower the risk to an acceptable level, (2) are practicable, and (3) are economically feasible.

3.4.1.3 Determine the Appropriate Level of Personal Protection Equipment. The Navy and its contractors use air monitoring data to determine the appropriate level of personal protection at hazardous waste sites. Under these circumstances, the field personnel gather air samples from the breathing zone to provide the basis to select personal protection equipment. The Health and Safety Plan outlines the selection of personal protection equipment.

3.4.2 Air Evaluation Process

The process for evaluating air quality conditions begins with a review of the Site history, and includes evaluations of existing data as PSCs are investigated, identification of constituents of concern, and air sampling. These processes are described below.

3.4.2.1 Review of Existing Data and Records. The Site history and description assist in the design of the air sampling program by indicating those chemicals that should be sampled. The Navy and its contractors use the physical characteristics of the chemicals to predict those that may be detected in the breathing zone and transported to off-site receptors. The Site background and history are described in Section 3.0 of Volume 1, Organization and Planning and in Section 2.0 of the OU specific plans.

Previous investigations may provide valuable insight into existing conditions. If these data were sampled incorrectly, obtained at an inappropriate time, or analyzed by incorrect methods, then they may have qualitative value only. The Navy and its contractors will review data from previous investigations for representativeness before the start of the air sampling program.

A physical description of the PSC assists in the design of the air sampling program. Before designing an air sampling program, the Navy and its contractors should conduct a PSC visit to corroborate historical information, to confirm the potential for airborne releases at the PSC, and to select potential air sampling stations.

A variety of constituents may have been reported in either soil, ground-water, sediment, or air samples. Many of these constituents may be inappropriate for air sampling and analysis. The Navy and its contractors will use a hazard analysis to designate those constituents of greatest human health concern.

3.4.2.2 Establishing Criteria for Data Evaluation. Evaluating the data collected as a result of implementing the Air Sampling Plan is a function of two criteria: (1) regulatory standards for the constituents of concern, and (2) analytical detection limits.

A review of existing federal, state, and local air regulations will provide a basis to determine the most precise and appropriate analytical method and corresponding detection limits for air sampling studies. The Navy and its contractors will identify Federal, state, and local air quality standards and criteria will be identified to select the appropriate analytical methods. It is essential that the analytical methods selected have detection

limits that are equal or less than the standards and criteria established for the chemicals of concern.

The applicable, relevant, and appropriate requirements (ARARs) provide an understanding of the standards that the remedial alternative(s) must meet. The Navy and its contractors will review air ARARs to assure that when possible the analytical detection limits of the air sampling program are equal to or less than the ARAR. Without this assurance, it would be difficult to determine whether data obtained from the air sampling program could be used in the risk assessment.

Understanding the analytical methods and detection limits will support the design of the air sampling program and risk evaluation efforts. A review of existing data for the PSC under investigation will provide the basis for selecting constituents of concern.

3.4.3 Field Sampling Program

Additional air monitoring data may be necessary to characterize the PSC. Physical conditions at the PSC or the availability of additional PSC information may indicate the need for additional air monitoring information. For this reason, the field personnel may include analytical parameters not included in previous work for sampling and analysis.

PSC-specific conditions may affect the representativeness of air samples. Meteorology, sampling locations, sampling methodologies are based on PSC-specific conditions.

The field personnel will evaluate meteorological data to determine the worst case circumstances for sampling, i.e., time of day and month. This will assure the usefulness of the data for risk assessment calculations. The field personnel will obtain up-

to-date wind directions, ambient temperatures, and humidity from the nearest meteorological station to select the worst case conditions for air sampling.

The field personnel will use ambient air data to establish background chemical vapor concentrations at the PSC. These measurements may be particularly important at PSCs near gas stations, air landing strips, and manufacturing facilities. Once the ambient concentrations of chemical vapors are established, the field personnel can more easily quantify identification of chemical vapors from source areas.

The field personnel will select individual sampling locations based on the intended location(s) of remedial activities, proximity to the nearest off-site receptors, and climatological information. The field personnel will base the duration and periodicity of air sampling on the constituents of concern, baseline conditions, analytical methodology, and proposed remedial activities. The Navy and its contractors will describe the number, frequency, and location of samples in the specific work plans for each PSC being investigated.

Specific procedures for collection of ambient air samples are presented in Section 4.12 of the BFSP (Appendix 4.4.2).

3.4.4 Analytical Methodology

The constituents of concern will determine the selection of the analytical methodology. Federal and state criteria, in addition to health-based risk assessment objectives, will determine the sensitivity of the analytical methods.

Method sensitivity and detection limits vary with the instrument, the analyte measured, the complexity of the sample

matrix, and the technique of the method selected. Sensitivity is defined as the analyte concentration that produces a response in an analytical system of a given amount. Typically the method sensitivity is lower than the detection limit.

Analytical quality control measures represent the procedures and checks performed during the analysis to assure that the analytical system was operated under controlled conditions. These controls help to assure that the reported results are of acceptable accuracy and precision.

Reportables represent the legal evidence that the laboratory performed the analyses according to EPA methodology. Should the analytical information obtained from an air sampling program come under regulatory scrutiny, the reportables substantiate the analytical aspects of the program.

Specific analytical procedures and Quality Assurance procedures used in analyses of ambient air samples will be presented in the QAPjP for each OU.

3.4.5 Data Manipulation

The Navy and its contractors will compile air data for use in the risk assessment, feasibility study, and health and safety planning. Under baseline conditions, air modeling allows the calculation of risk under existing conditions. In the feasibility study, the Navy and its contractors may use air modeling to predict human health risk corresponding to the selection of a remedial alternative.

3.4.5.1 Air Modeling. The Navy and its contractors use air modeling to predict the fate and transport of airborne

constituents. This technique is often used to predict human health risks via airborne exposure at off-site receptor populations.

3.4.5.2 Data Evaluation. Following compilation of the air sampling results and completion of the air modeling results, the Navy and its contractors will compile and compare all data to regulatory standards. This process identifies chemicals that exceed promulgated criteria and standards established by the federal, state, and local governments.

3.4.5.3 Health Risk Calculation. Health risk calculations represent the ultimate use of data collected from an air monitoring program. The Navy and its contractors use chemical vapor concentrations in air and human exposure information (body weight, duration of exposure, length of exposure, absorption rates, etc.) to derive the magnitude of human health risk. Once the Navy and its contractors determine the magnitude of human health risk, these risk levels are used to select the appropriate remedial action alternative.

(a) No Further Action Alternative. The Navy and its contractors will select the no further action alternative when there are minimal acceptable health risks. The toxicological characteristics of the chemical vapors, the probability of exposure to human receptors, and regulatory considerations determine the degree of acceptable risk.

(b) Remedial Alternatives. The Navy and its contractors will select remedial alternatives when the human health risks exceed acceptable levels. The acceptable risk levels for carcinogenic compounds may range from 1×10^{-4} to 1×10^{-6}. An acceptable hazard index for noncarcinogenic compounds is less than one.

3.5 Ecological Investigation

The Navy and its contractors use the ecological investigation to identify the natural resources of the PSC and ecological communities that are present. The results of the investigation will be used to assess the impact of releases at a PSC, with or without remedial activities, on the local environment. A detailed description of the tasks necessary to complete an Ecological Assessment at each OU will be presented in the specific OU Work Plan.

3.5.1 Background Information

Background information is compiled using the following information:

County Soil Survey(s)
U.S. Fish & Wildlife Service National Wetland Inventory
Map Installation Studies:
    Natural Resources Management Plan
    Special Studies/Field Data Collected Under the Plan
Rare & Endangered Species List
Aerial Photographs at best available scale
List of expected contaminants & their known or suspected fate in the ecosystem

3.5.2 OU Visit

A visit to the OU will be performed to classify it into ecological communities in accordance with the Florida Natural Areas Inventory's (FNAI) Natural Communities Classification System. (Unnatural communities will be designated in an appropriate manner, e.g., field, pasture, ruderal, man-made pond, exposed soil, etc.) Each community will have its FNAI global or state ranking recorded. Within each community, the dominant plant species will be recorded for the herb, shrub, understory, and overstory layers. Dominance will be based on some appropriate measurement such as basal area,

number, crown coverage, etc. The most dominant species which (together) comprise 50% of the dominance measure will be recorded as will other species that comprise greater than 20% of the dominance measure for the appropriate strata. Other species (or more general taxa) that are noted for fruit production (e.g., Rubus sp., Quercus sp., etc.) will also be recorded if the observer considers them to be significant. Aquatic habitats will be described using the same approach but through the use of aquatic sampling techniques. The primary fish and wildlife species associated with each community, based on the literature and location, will be determined.

3.5.3 Evaluation

For communities suspected or known to transport contaminants, the transport path(s) and potential receiver(s) of the contaminant (e.g., other community or animal taxa) will be described. Downgradient communities will be identified based on the estimated distance at which the contaminant would become too dispersed or otherwise not discernible, or until the contaminant would become accessible to the public or a rare or endangered species or habitat via some transport vector.

Based on the information collected on site and the list of known and suspected contaminants, the specific pathways for contaminants to reach humans or rare and endangered species or communities will be determined. Key components of these pathways will be selected for future sampling.

3.5.4 Testing

Components will be sampled and contaminants will be tested in accordance with the Compendium of CERCLA Response Selection

Guidance Documents and the Superfund Public Health Evaluation Manual or other appropriate test.

3.5.5 Reporting

The extent of public health endangerment and ecosystem contamination will be reported. The communities and species to be protected during remedial action will be listed as well as any new contaminant pathways that may be created by remedial action. Measures necessary to protect human health during remedial action will also be determined.

3.5.6 Soil Microbiological Analysis

Bioremediation is a potentially cost-effective method to treat soil and ground-water contaminants. Bioscreening is used to determine the potential applicability of bioremediation based on constituent type, geological conditions, and the suitability of micro-organisms at an OU. A soil microbial analysis will be performed to identify the presence of aerobic bacteria capable of oxidizing organic chemicals detected at the OU.

3.5.6.1 Methodology. The objective of the microbial analysis is to determine whether naturally-occurring microbes can biodegrade chemicals detected at the OU. This objective is accomplished in three steps: (1) soil collection and extraction, (2) bacterial plating and enumeration, and (3) bacterial evaluation of specific carbon source degradation.

3.5.6.2 Interpretation of Results. The results obtained from the bacterial evaluation will determine whether bioremediation alternatives may be implemented at the OU. Two experimental results may indicate that bioremediation is not appropriate for the OU. These results are (1) the absence of aerobic microbes in soil

samples, and (2) the inability of aerobic microbes to oxidize chemicals detected at the OU. Experimental results indicating that aerobic microbes are present in sufficient number and are capable of oxidizing the chemicals of concern would support the applicability of bioremediation.

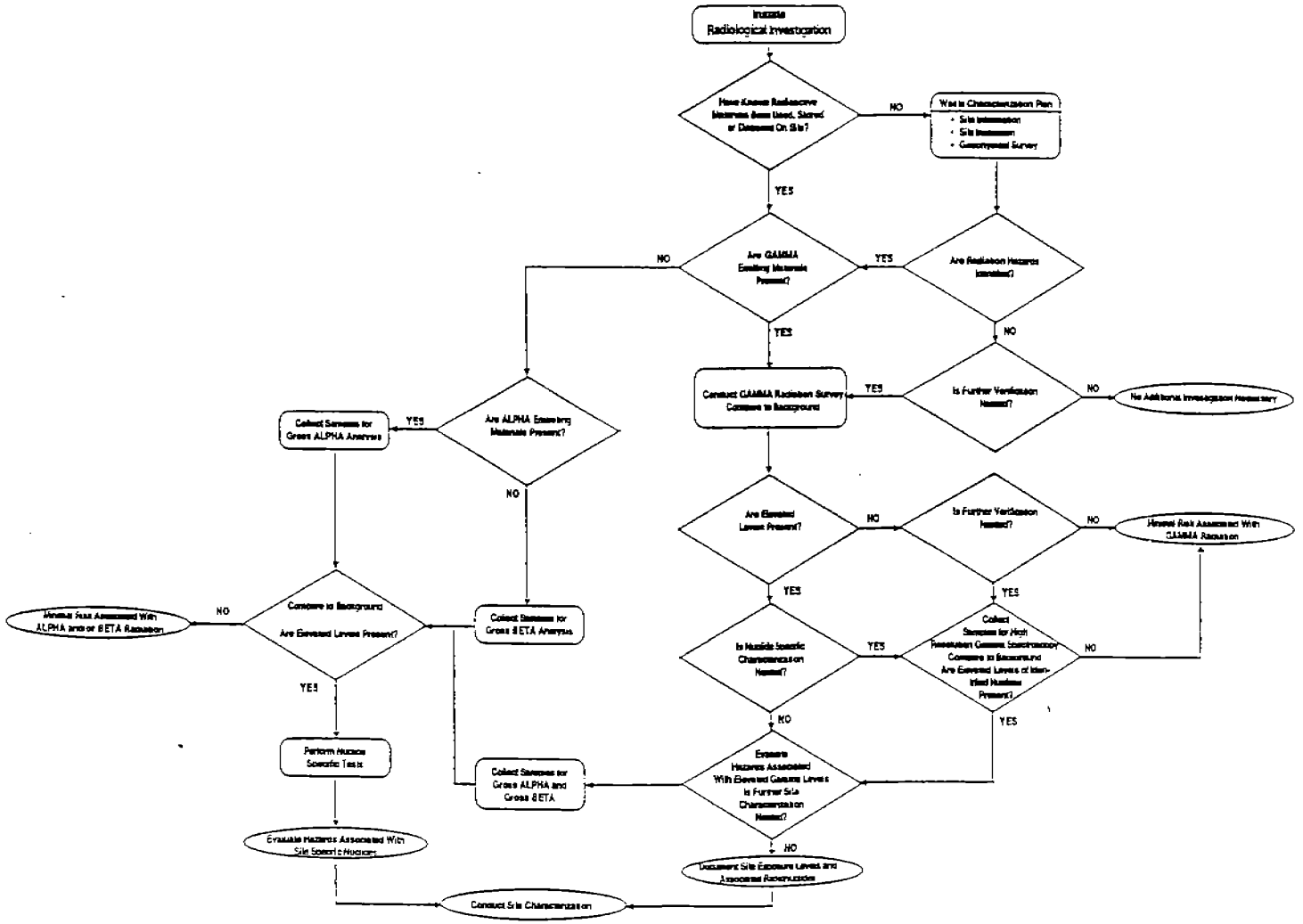
3.6 Radiological Investigation Plan

The objective of the radiological investigation is to evaluate a selected PSC for its radiological condition. The primary tasks performed in achieving this objective may include the following:

- o review of available PSC information
- o evaluation of hazards associated with identified radionuclides
- o gamma radiation PSC surveys
- o collection of water and soil samples
- o determination of background radioactivity levels
- o analysis of water and soil samples for radioactivity parameters
- o comparison of PSC radioactivity levels to background levels

The Flow Chart in Figure 3-3 illustrates the course of the radiological investigation. The Flow Chart will be used to determine whether radioactive materials are present at PSCs and will provide a systematic procedure for evaluating the types of materials and hazards associated with the PSCs.

RADIOLOGICAL INVESTIGATION FLOW CHART



REMEDIAL INVESTIGATION/
FEASIBILITY STUDY
WORK AND PROJECT
MANAGEMENT PLAN
NAS JACKSONVILLE
SEPTEMBER 1991

RADIOLOGICAL INVESTIGATION
FLOW CHART
FIGURE 3-3

The Flow Chart consists of pathways based on the availability of information on past or current use of radioactive materials at PSCs. If specific radionuclides are present, a mechanism is presented to collect pertinent information on the materials. The Navy and its contractors then evaluate the information collected to determine whether a radiation hazard may exist. If further information is needed, Section 3.6.3.1 presents guidelines for radiation screening and performing gamma site surveys and for collecting soil and water samples for gamma spectroscopy, gross alpha, and/or gross beta analyses. Alternatively, if the radiation hazard present at a PSC is unknown, the Navy and its contractors will develop a process for the collection of OU information and evaluation of potential radiation sources.

The following sections describe the procedures for collecting OU information, evaluating radionuclide information, and conducting measurements of alpha, beta, and gamma radioactivity.

3.6.1 Review of Existing Data

The Navy and its contractors may undertake a review of existing PSC documentation, PSC inspections, topographic surveys, and geophysical surveys in evaluating potential sources of radioactive materials that may have been used, stored, or disposed at an OU. Details on the collection of OU information are described in the Waste Characterization Plan (Section 3.1).

3.6.2 Evaluation of Identified Radioactive Materials

For each radionuclide associated with an OU, the Navy and its contractors will evaluate the type of radioactivity, half-life, decay products, and chemical properties in determining the potential radiological hazard. Table 3-3 presents the properties of the radioactive materials found in previous Site investigations.

Table 3-3. Radioactive Materials Used or In Use at NAS Jacksonville

Nuclide	Major Type of Radiation	Half-Life	Use	Properties	Decay Products
RA-226	alpha	1600 years	Radium Paint for Gauges	Soluble in water	Rn-222 Po-218 Pb-214 Po-210
RA-228	Beta	5.75 years	Radium Paint for Gauges	Soluble in water	Ac-228 Th-228 Ra-224 Rn-220 Po-216

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3.6.2.1 Types of Radioactivity. The three basic forms of radioactivity are gamma rays, alpha particles, and beta particles. Gamma rays, which are equivalent to photons, may present the greatest hazard from external dose due to their low attenuation in air and soil. This property also makes gamma radiation the easiest to detect. Alpha and beta particles have a much lower range in air due to their size and are much more difficult to detect.

3.6.2.2 Half-Life. A half-life is the time required for a radioactive material to decay to one-half of its activity. Evaluating the half-life of materials associated with the PSC can be used in determining whether radioactive hazards still exist. Assuming the source of a radioactive material has long since been eliminated, a material with a relatively short half-life (<5 years) may have had sufficient time for its activity to be significantly reduced. After seven half-lives less than one percent of the original material is present.

3.6.2.3 Decay Products. When a radioactive material decays, it is transformed into a new material. This new material is called a decay product. In some instances the decay product is a stable material that does not undergo radioactive decay. In other instances, the new material formed is radioactive. The Navy and its contractors will evaluate the decay products of radioactive materials identified at an OU. The Navy and its contractors will conduct the evaluation of the decay products in accordance with the procedures used to evaluate the original radioactive material.

3.6.2.4 Chemical and Physical Properties. The Navy and its contractors will evaluate chemical and physical properties to determine the relative mobility of identified radionuclides and their decay products. These data will be useful in evaluating the potential areal extent of migration within the environment.

3.7 Remedial Investigation Report

The format of the Remedial Investigation Report is presented in Table 3-4. The report includes the investigation tasks performed and the results of implementing the investigation. The risk assessment is also included in the Remedial Investigation Report as outlined in Section 4.0. The results of the risk assessment are essential to determining remedial action objectives and identifying the appropriate remedial action alternatives for waste management.

Table 3-4. Remedial Investigation Report Format

-- Executive Summary

1.0 Introduction
- 1.1 Purpose of Report
- 1.2 OU Background
  - 1.2.1 OU Description
  - 1.2.2 OU History
  - 1.2.3 Previous Investigations
- 1.3 Report Organization

2.0 Study Area Investigation - OU Characterization Tasks
- 2.1 Field Activities Descriptions
  - 2.1.1 Surface Features
  - 2.1.2 Contaminant Sources
  - 2.1.3 Meteorological Investigation
  - 2.1.4 Surface-Water Investigation
  - 2.1.5 Sediment Investigation
  - 2.1.6 Geological Investigation
  - 2.1.7 Soil and Vadose Zone Investigation
  - 2.1.8 Ground-Water Investigation
  - 2.1.9 Human Population Survey
  - 2.1.10 Ecological Investigation
- 2.2 Technical Memoranda

3.0 Physical Characterization of Study Area
- 3.1 Surface Features
- 3.2 Geological Investigation
- 3.3 Soils
- 3.4 Surface Water Hydrology
- 3.5 Hydrogeology
- 3.6 Meteorology
- 3.7 Demography and Land Use
- 3.8 Ecological Investigation

4.0 Nature and Extent of Contamination
- 4.1 Ground Water
  - 4.1.1 Dug (Test pits, trench)
  - 4.1.2 Wells
  - 4.1.3 Potable Water (Wells)
- 4.2 Surface-Water
  - 4.2.1 Lakes, rivers, stream
  - 4.2.2 Surface Impoundments
  - 4.2.3 Marine water bodies
- 4.3 Sediments
- 4.4 Soil
  - 4.4.1 Surface Soil
  - 4.4.2 Soil Borings and Subsurface Soil
- 4.5 Sludge
- 4.6 Waste Streams
- 4.7 Waste Piles
- 4.8 Landfills

Table 3-4. Remedial Investigation Report Format

4.9 Closed/Open Containers
4.10 Ambient Air

5.0 Contaminant Fate and Transport
5.1 Potential Routes of Migration
5.2 Contaminant Persistence
5.2.1 Estimated Persistence-Physical, Chemical, Biological
5.2.1.1 Ground Water
5.2.1.2 Surface Water
5.2.1 3 Sediments
5.2.1 4 Soil
5.2.1 5 Sludge
5.2.1 6 Waste Streams
5.2.1 7 Waste Piles
5.2.1.8 Landfills
5.2.1.9 Closed/Open Containers
5.2.1.10 Ambient Air
5.3 Contaminant Migration
5.3.1 Ground Water
5.3.2 Potable Water (Wells)
5.3.3 Surface-Water
5.3.4 Sediments
5.3.5 Soil
5.3.6 Sludge
5.3.7 Waste Streams
5.3.8 Waste Piles
5.3.9 Landfills
5.3.10 Closed/Open Containers
5.3.11 Ambient Air
5.4 Modeling

6.0 Baseline Risk Assessment
6.1 Human Health Evaluation
6.1.1 Exposure Assessment
6.1.2 Toxicity Assessment
6.1.3 Risk Characterization
6.2 Environmental Evaluation

7.0 Summary and Conclusions
7.1 Summary
7.1.1 Nature and Extent of Contamination
7.1.2 Fate and Transport
7.1.3 Risk Assessment
7.2 Conclusions
7.2.1 Data Limitations
7.2.2 Recommended Future Work
7.2.3 Recommended Remedial Action Objectives

Appendices

4.0 RISK ASSESSMENT

A risk assessment will be performed as part of each OU-specific RI to determine the current and potential risk to human health and the environment associated with constituents released to the environment as a result of past activities at the OU. Risk assessments are performed to accomplish two specific objectives: the evaluation of baseline risk and the identification of remedial goals. The two objectives are discussed in the following paragraphs.

The analysis of baseline risk identifies the risks that exist if no remedial actions or institutional controls are implemented at an OU. The results of the baseline risk assessment are used to determine if implementation of the no further action alternative is feasible at an OU or if remedial actions are necessary. If baseline risk levels indicate that remedial action is necessary, the baseline risk assessment is used to identify the exposure pathways that need to be remediated.

The second major objective of risk assessments performed in connection with CERCLA RI/FS activities is the identification of remediation goals. The risks and exposure pathways developed in the baseline risk assessment are used to target chemical concentrations associated with risk levels that will be adequately protective of human health for a particular OU. A similar process is employed to assess threats to ecosystems and the environment for development of remediation goals based on risk to the environment.

The Risk Assessment Report is based on guidelines specified "Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A), Interim Final" (EPA, December, 1989). The environmental assessment part of the risk assessment follows guidelines given in the EPA document "Risk Assessment Guidance for

Superfund, Volume II, Environmental Evaluation Manual, Interim Final," March 1989.

4.1 Data Collection

To perform an OU-specific risk assessment, the following types of data are necessary: the identity of contaminants, concentrations of contaminants in the media of interest, contaminant source characteristics, and specific environmental characteristics that may affect the fate, transport, and the persistence of contaminants. Before sampling strategies are made final, the risk assessor will identify the human exposure points, potential exposure routes, and type and length of possible exposure for each contaminated media. Information about the OU may be obtained from several sources (i.e., the RI, photographs, hazardous substance disposal information, etc.). Using these sources, the number, type, and location of samples needed can be determined. Only data that is reliable, accurate, and verifiable can be used in the quantitative risk assessment; data not meeting criteria can be discussed either qualitatively or used elsewhere.

Background samples are collected to determine whether contaminants are either naturally-occurring at the OU or non-OU-related contaminants. Background samples are collected from each media of concern in areas not influenced by constituents released to the environment at the OU.

4.2 Data Evaluation

The project team will gather data collected from all available sources. The data must be validated according to the steps outlined in the QAPP before it is used in the risk assessment. If contaminant concentrations change significantly between sampling periods, then it may be useful to keep data separate. The most recent data may be included in the quantitative risk assessment,

while older data may be evaluated qualitatively. Justification for elimination of data sets must be fully documented.

Analytical results that do not specify a particular compound (e.g., total organic carbon [TOC]) and analytical results that are obtained from less precise analytical methods (e.g., organic vapor analyzer and field gas chromatography) are not appropriate for use in a quantitative risk assessment.

4.3 Exposure Assessment

In EPA, 1989a, the stated objective of the exposure assessment is "to estimate the type and magnitude of exposures to the chemicals of potential concern that are present at or migrating from a site. The results of the exposure assessment are combined with chemical-specific toxicity information to characterize potential risks".

"Exposure is the contact of an organism ...with a chemical or physical agent. The magnitude of exposure is determined by measuring or estimating the amount of an agent available at the exchange boundaries (i.e., the lungs, gut, skin) during a specified time period. Exposure assessment is the determination or estimation (qualitative or quantitative) of the magnitude, frequency, duration, and route of exposure. Exposure assessments may consider past, present, and future exposures using varying assessment techniques for each phase" (EPA, 1989a). Superfund exposure assessments are concerned with current and future exposures.

The toxicologist initiates the exposure assessment after all data has been collected and validated, and chemicals of potential concern have been chosen. The three steps involved in the exposure assessment are as follows: characterization of exposure setting, identification of exposure pathways, and quantification of

exposure. The exposure setting describes the physical characteristics of the OU (climate, vegetation, presence/absence of surface water, etc.) and characteristics of population (locations, activity patterns, sensitive subpopulations, etc.) on and near the OU. Human populations would include current and potential future populations projected for alternate land uses.

Previously identified populations can be revealed during an exposure pathway analysis. Each exposure pathway has a unique mechanism of exposure and is based on the following: (1) the sources, releases, types, and locations of OU-related chemicals; (2) the environmental fate; and (3) the location and activities of potentially exposed populations. The toxicologist will identify exposure points (points of actual contact with the chemical) and exposure routes.

In the quantification of contaminant exposure, the toxicologist determines the magnitude, frequency, and duration of exposure for each exposure pathway. The quantification of exposure is conducted by the following steps: (1) estimating exposure concentrations (the concentration of chemicals contacted through the entire exposure period) and (2) calculating chemical intakes in mg/kg-day using equations that include variables for exposure concentration, contact rate, exposure frequency, exposure duration, body weight, and exposure averaging time. Estimates of dose intakes are organized by the type of population. Following these steps, the sources of uncertainty (e.g., variable assumptions, variability in data) are evaluated and summarized. The conclusion of this section is presented as a summary of the estimated intakes for each exposure pathway.

As stated in EPA, 1989a, "Actions at Superfund sites should be based on an estimate of the reasonable maximum exposure (RME) expected to occur under both current and future land-use conditions. RME is defined here as the highest exposure that is

reasonably expected to occur at a site...and are estimated for individual pathways. If a population is exposed via more than one pathway, the combination of exposures across pathways also must represent an RME. The intent of the RME is to estimate a conservative exposure case (i.e., well above the average case) that is still within the range of possible exposures."

4.4 Toxicity Assessment

"The purpose of the toxicity assessment is to weigh available evidence regarding the potential for particular contaminants to cause adverse effects in exposed individuals and to provide, where possible, an estimate of the relationship between the extent of exposure to a contaminant and the increased likelihood and/or severity of adverse effects." (EPA, 1989a).

The two steps involved in toxicity assessment are:

(1) Determining whether exposure to an agent is likely to cause an increase in the incidence of any adverse health effect in humans (hazard identification); and

(2) Quantitatively evaluating the available toxicity information to derive an estimate of the potential for adverse health effects as a function of human exposure to the agent (dose-response evaluation). The EPA has performed these steps for numerous chemicals and has made available the resulting toxicity information and toxicity values.

4.5 Risk Characterization

Risk characterization is the final step in the risk assessment process. The toxicologist calculates risk estimates separately for carcinogenic (Integrated Risk Information System [IRIS], 1990) and

non-carcinogenic effects by combining the appropriate information from the toxicity and exposure assessment sections.

Because many chemicals and exposure pathways may exist at an OU, the information must be sorted and checked for completeness. The toxicologist will evaluate each exposure pathway and land use scenario for necessary exposure and toxicity information. A checklist from EPA 1989a is provided below:

Exposure Information

- Estimated intakes (chronic, subchronic, and shorter-term, as appropriate) for chemicals.
- Important exposure modeling assumptions, including:
  - chemical concentration at the exposure point;
  - frequency and duration of exposure;
  - absorption assumptions; and
  - characterization of uncertainties.

- List of which exposure pathways can reasonably contribute to the exposure of the same individuals over the same period.

Toxicity Information

Toxicity information for risk characterization includes:

1) "Slope factors" for all carcinogenic chemicals;

2) Discussion of weight of evidence and classifications for all carcinogenic chemicals;

3) Type of cancer for Class A carcinogens;

4) Chronic and subchronic RfDs and shorter-term toxicity values (if appropriate) for all chemicals (including carcinogens and developmental toxicants);

5) Critical effect associated with each RfD;

6) Discussion of uncertainties, uncertainty factors, and modifying factor used in deriving each RfD and 'degree of confidence' in RfD (i.e., high, medium, low);

7) Whether the toxicity values are expressed as absorbed or administered doses;

8) Pharmacokinetic data that may affect the extrapolation from animals to humans for both the RfD and slope factor; and

9) Uncertainties in any route-to-route extrapolations. (EPA, 1989a).

EPA, 1989a, states that it is important to "Check the consistency and validity of key assumptions common to the exposure outputs and the toxicity outputs for each contaminant and exposure pathway of concern. These assumptions include the averaging period for exposure, the exposure route, and the absorption adjustments. The basic principle is to ensure that the exposure estimates correspond as closely as possible with the assumptions used in developing the toxicity values."

The toxicologist calculates carcinogenic risks by multiplying the average daily intake by the slope factor. The slope factor is the upper 95 percent confidence limit (based on the multistage model) of the dose-response curve and is usually based on laboratory animal studies. The result is a probability estimate known as the excess lifetime cancer risk (ELCR). This estimate,

according to EPA, 1989a, is "the incremental probability of an individual developing cancer over a lifetime as a result of exposure to the potential carcinogen." The model assumes that any dose of a carcinogen could theoretically cause cancer (i.e., there is no threshold dose below which effects would not occur). A risk estimate of 1×10^{-6} means that the individual exposed would have an expected additional probability (i.e., above background) of one chance in a million of developing cancer. Or, in other words, if one million people were exposed, one excess cancer case would be expected. Because the risk estimate is based on the upper-bound slope factor, the EPA is reasonably sure that the true risk will not exceed the risk estimate derived from the above method.

The risk estimates derived for non-carcinogenic effects are not expressed as the probability of an effect but as the ratio, hazard quotient (HQ), of the average intake for the exposure period to the appropriate RfD. This approach assumes that there is a threshold dose that must be exceeded for an effect to occur. An HQ of greater than one indicates that the acceptable dose has been exceeded and that there is reason for concern. It is important to include RfDs for the non-cancer effects for the carcinogens in the calculations. However, "it is important to emphasize that the level of concern does not increase linearly as the RfD is approached or exceeded because RfDs do not have equal accuracy or precision and are not based on the same severity of toxic effects. Thus, the slopes of the dose-response curve in excess of the RfD can range widely depending on the substance." (EPA, 1989a). The HQs will be calculated separately, if appropriate, for short-term, subchronic, and chronic exposures as discussed in the Averaging Period Subsection.

4.5.1 Assessment of Uncertainty

The risk measures used in Superfund risk assessments usually are not fully probabilistic estimates of risk, but conditional estimates given a considerable number of assumptions about exposure and toxicity (e.g., risk given a particular future land use). Thus, it is important to fully specify the assumptions and uncertainties inherent in the risk assessment to place the risk estimates in proper perspective. Another use of uncertainty characterization can be to identity areas where a moderate amount of additional data collection might significantly improve the basis for selection of a remedial alternative.

4.5.2 Other Considerations

In some cases, site-specific human health studies may be available. If the site is a Superfund National Priorities List (NPL) site, then the Agency of Toxic Substances and Disease Registry (ATSDR) will have completed a preliminary health assessment for the site. The Navy should review and compare such information to the risk assessment. It is important that the risk assessment identify all the exposure pathways and chemicals of concern that were discussed in the other documents. Any differences in conclusions should be explained.

4.5.3 Summary of the Results

The final discussion of the risk characterization results is a key component of the RI Report. At a minimum, the discussion should include the following:

(1) Verification that the key site-related contaminants were identified and contaminant concentrations relative to background concentration ranges were discussed;

(2) A description of the various types of cancer and other health risks present at the OU (e.g., liver toxicity, neurotoxicity), distinguishing between known effects in humans and those that are predicted to occur based on animal experiments;

(3) The quantitative toxicity information used to estimate risks and presentation of qualitative information on the toxicity of substances not included in the quantitative assessment;

(4) The exposure estimates for key exposure pathways and related exposure parameter assumptions;

(5) The magnitude of the cancer risks and noncancer hazard indices relative to the Superfund site remediation goals in the NCP (e.g., the cancer risk range of 10^{-4} to 10^{-7} and noncancer hazard index of 1.0);

(6) The major factors driving the OU risks (e.g., substances, pathways, and pathway combinations);

(7) The major factors reducing the certainty in the results and the significance of these uncertainties (e.g., adding risks over several substances and pathways);

(8) Exposed population characteristics; and

(9) Comparison with site-specific health studies, when available.

4.6 Environmental Assessment

This section provides general guidance for performing environmental assessments at Superfund Sites. The issues and information presented in the following text outline and briefly describe the basic components of an environmental risk assessment. This information is consistent with guidance provided in the

document entitled "Risk Assessment Guidance for Superfund, Volume II, Environmental Evaluation Manual - Interim Final." (EEM) (EPA, 1989m).

There are other documents that the ecological risk assessor should review both before and during an environmental assessment. The suggested (in EEM) reference document that provides guidance concerning the design, implementation, and interpretation of the data and information gathered during an environmental assessment is entitled "Ecological Assessment of Hazardous Waste Sites: A Field and Laboratory Reference" (EPA, 1989n). The toxicologist will consult other references prepared by the USEPA that provide useful information. These are listed below:

(1) Review of Ecological Risk Assessment Methods (EPA, 1988e);

(2) The Nature and Extent of Ecological Risks at Superfund Sites and RCRA Facilities (EPA, 1989o);

(3) Ecological Risk Assessment Methods: A Review and Evaluation of Past Practices in the Superfund and RCRA Programs (EPA, 1989p);

(4) Ecological Risk Management in the Superfund and RCRA Programs (EPA, 1989q); and

(5) Summary of Ecological Risks, Assessment Methods, and Risk Management Decisions in Superfund and RCRA (EPA, 1989r).

The basic components that should be included in an ecological assessment include: objectives of the assessment, scope of the assessment, site characterization, constituents of concern, exposure characterization, risk characterization, and conclusion and uncertainty.

4.6.1 Objectives of the Assessment

An environmental assessment may be conducted at an OU for a number of reasons, ranging from the evaluation of actual (or potential) on-site and/or off-site impact to biotic communities, to assessing the potential or observed environmental effects of remediation activities (EPA, 1989m). It is important that the toxicologist state the objective of the investigation clearly so that the reader understands the specific nature and direction of the assessment.

4.6.2 Scope of the Assessment

This section of the report describes the type (i.e., grab vs. composite water samples, depth of sediment core samples, etc.) and quantity of data that was collected in association with the investigation. The risk assessor will present the data in a tabular format that summarizes the occurrence of the data in the sampled environmental media (i.e., soil, surface water, sediment, air). It is also important that the table describes the data "...in terms of the physical, biological, and chemical parameters measured, estimated, or calculated in the assessment." (EPA, 1989m). Additionally, the toxicologist should discuss the length of time during which the data was collected, the time intervals between sample collection, and season(s) of the year during which data collection occurred. These facts are necessary to provide the reader with an indication of the nature, depth, and limitations of the assessment.

4.6.3 OU Characterization

This section provides a description of the physical setting of the OU, and any off-site areas that may have been affected by release of OU-related contaminants. This description is dependent on the scope of the assessment. Specific information to be

included are size of the study area, and resident physical features (i.e., stream reaches, roads, wetlands, ground cover, etc.)

A thorough description of the potentially exposed ecosystems and populations will be included with a cataloguing of the habitats. It is useful to prepare a list of the species collected or observed in each habitat, and where relevant, the following species should be labeled: resident, breeding or a rare or frequent transient (e.g., migrating waterfowl); endangered or threatened; or a natural resource trustee concern.

Adequate characterization of the OU may also involve knowledge and recognition of the importance of such factors as current or projected land uses; proximity of the study area to human population centers, industry, agriculture, or hunting areas; and special climate conditions affecting movement, availability, or effects of contaminants.

The OU characterization will also include information about potential exposure pathways via affected media (e.g., surface water, vegetation, sediments, etc.), and any observed adverse effects that may be the result of contaminant release from the site (e.g., fish kills, stressed vegetation, etc.).

4.6.4 Constituents of Concern

The OU-specific RI/FS Work Plan will identify the constituents detected at the OU represent current or future hazards to the environment. The list of constituents identified may differ from those generated for use in assessing potential human health risks at the OU because a specific constituent may not be as toxic to mammals as to lower organisms such as fish, invertebrates, and plants.

4.6.5 Exposure Characterization

The identification of actual and potential exposure pathways is an important component of the assessment. The fate and transport of constituents in affected media is discussed with respect to the exposure pathways. The environmental risk assessor shall consult SEAM (EPA, 1988b) and environmental specialists to ensure that all possible pathways have been considered.

If any of the exposure pathways were generated using computer simulation models, then the models' inherent assumptions will be stated clearly. EPA, 1989m stresses that the ecological risk assessor should thoroughly discuss the limitations and uncertainty of not only the parameters that are measured and modeled, but also any data obtained from effects-related studies (e.g., population studies, etc.).

4.6.6 Risk Characterization

There are several basic questions that the environmental risk assessor will answer in investigations at Superfund sites:

(1) "What is the potential that an adverse effect(s) will occur?

(2) What is the magnitude of each effect?

(3) Are the adverse effects of a permanent, reversible, or temporary nature? and

(4) What receptors (e.g., infaunal benthic organisms, burrowing terrestrial organisms, plants, etc.) or habitats may be affected?" (EPA, 1989m).

The risk assessor presents the answers to these important questions quantitatively and/or qualitatively depending on the

scope, objectives, and quality of the data obtained in the assessment.

If State and/or Federal water-quality criteria (or other ARARs) have been exceeded at the study area, remediation activities may be warranted. The risk assessor must consider several other factors in addition to criteria exceeding situations for an in-depth risk characterization. These factors (from EPA, 1989m) include the following:

(1) "Contaminant concentrations in environmental media (soil, surface water, sediments) and biota;

(2) Site-specific toxicity test results;

(3) Toxicological data from peer-reviewed literature;

(4) Field surveys of receptor populations; and

(5) Studies of community structure and ecosystem integrity."

With the information and data obtained from the various studies, the environmental risk assessor will be able to evaluate whether an effect(s) is occurring. However, because ecosystems are dynamic, the information obtained during the assessment may be ambiguous and not indicate a clear-cut, definable cause and effect situation. In this case, the assessor must rely on weight-of-evidence and use professional judgement in drawing conclusions. There are several other basic questions that the ecological analyst addresses when considering the potential for future adverse environmental effects at a site; and these are discussed in EPA, (1989m).

Comparison of constituent concentrations to water quality criteria or other criteria (e.g., interim sediment quality

criteria) is presented in tabular form to allow the reader easy recognition of any trends, and can serve as the basis for remediation in certain situations. Remediation criteria can also be generated from risk information found in other environmental statutes, such as Toxic Substances Control Act (TSCA) and Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). All pertinent information (e.g., equations, parameters, and references for criteria calculation methods) used to derive remediation criteria (if needed) are presented in detail.

4.6.7 Conclusions and Uncertainty

In this section, the environmental risk assessor will, in addition to stating the conclusions, indicate "...the degree of success in meeting the objectives of the evaluation." (EPA, 1989m). For each conclusion, the risk assessor will discuss all information that either supports or fails to support the conclusion, and the inherent uncertainty accompanying each conclusion.

Most of the data used in evaluating environmental effects (both existing and potential future) have some degree of uncertainty. The risk assessor presents information summarizing the limitations of, and confidence in, the data used to evaluate the ecological integrity of the site. As specified in the guidance document (EPA, 1989m), the risk assessor will provide (at a minimum) the following sources of uncertainty:

(1) "Variance estimates for all statistics;

(2) Assumptions underlying use of statistics, indices, and models;

(3) The range of conditions under which models or indices are applicable; and

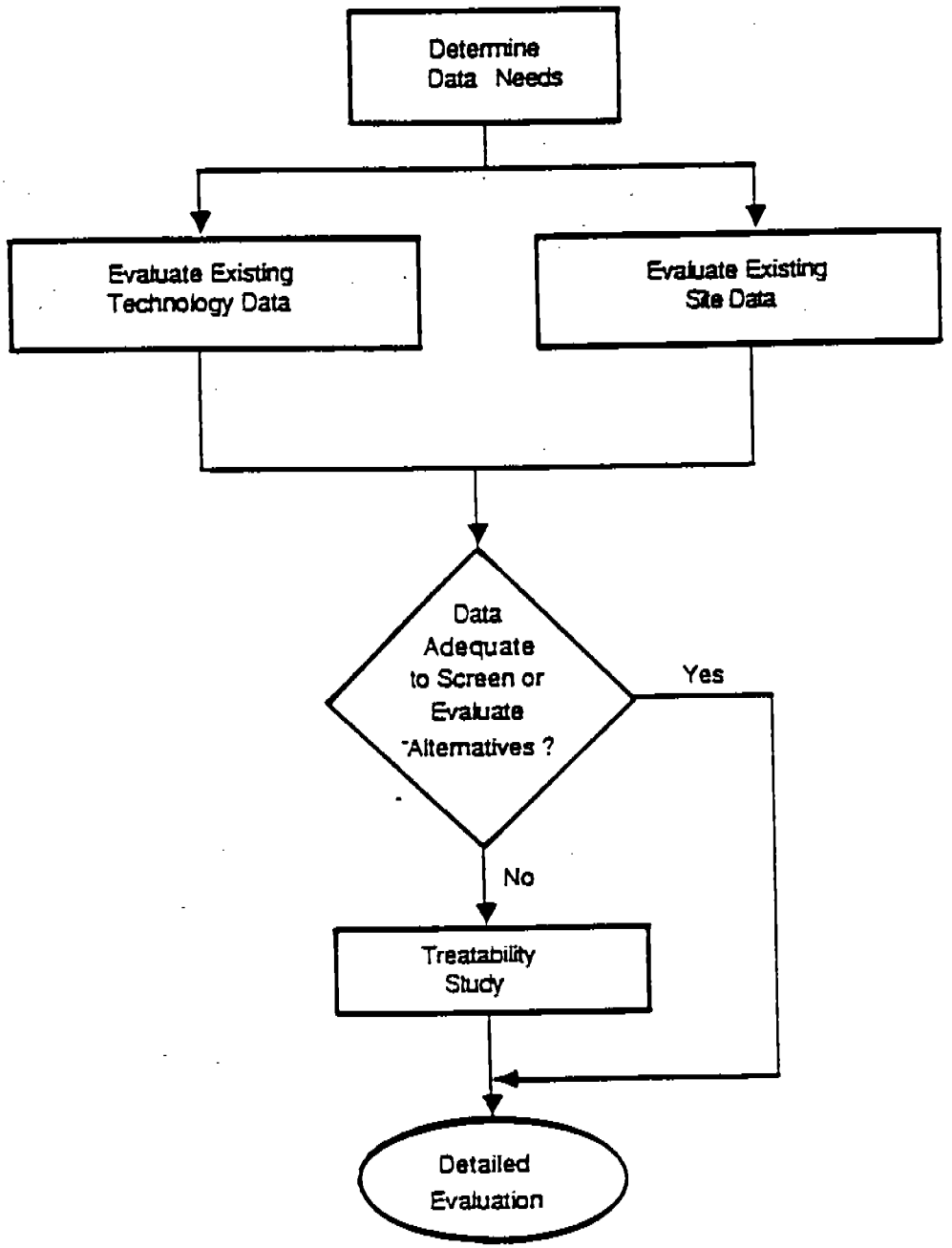
(4) Narrative explanations of other sources of potential error in the data (e.g., unexpected weather conditions, unexpected sources of contamination)."

5.0 TREATABILITY STUDIES

Treatability studies include bench-scale (laboratory) and/or pilot-scale (field) testing of potential treatment processes which may be appropriate at an OU. During the RI/FS, the Navy and its contractors will assess treatability data needs for specific media, constituents, and site conditions. The evaluation of the need for treatability studies will be performed as early as possible in the RI/FS process, since pilot testing often takes several months to complete. Figure 5-1 provides a framework for performing treatability investigations. Treatability studies would include a literature review followed by bench- and/or pilot-scale testing. Information obtained from treatability analyses may include removal efficiencies, stabilization or reaction byproducts, treatment time frames, material compatibility, equipment size requirements, and relative efficiencies of treatment performance.

A Literature Survey and Treatability Testing Statement of Work will be prepared if testing is required to evaluate remedial action technologies that merit further assessment. The Treatability Testing Statement of Work will provide an outline of the steps necessary to evaluate and initiate treatability testing. The Treatability Testing Statement of Work will also define the scope of treatability tests and schedule for implementing bench- and/or pilot-scale tests. A Treatability Study Sampling and Analysis Plan would be developed for implementing the work plan. The OU-specific RI sampling and analysis plans may be adequate for defining the sampling and analysis associated with the treatability studies.

The treatability testing data and results will be summarized in a Treatability Evaluation Report. The evaluation report will include a review of the technology's effectiveness, implementability, and actual results versus predicted results. Based on the preliminary remedial alternatives developed in the RI/FS, treatability analyses to evaluate source control measures



SOURCE: EPA "GUIDANCE FOR CONDUCTING REMEDIAL INVESTIGATIONS AND FEASIBILITY STUDIES UNDER CERCLA", OCT. 1988.

TREATABILITY INVESTIGATIONS

FIGURE 5-1

REMEDIAL INVESTIGATION/
FEASIBILITY STUDY
WORK AND PROJECT
MANAGEMENT PLAN

NAS JACKSONVILLE
SEPTEMBER 1991

and ground-water treatment processes may be necessary. The bacteria content of the soils and waste at each OU, appropriate stabilization agents, and applicability of vapor extraction are examples of remedial technologies for source control which may require treatability study evaluation. Treatability studies to delineate the need and/or efficiency of proposed water treatment techniques such as chemical and physical oxidation processes, biological treatment, and innovative treatment technologies may also be required. The recommended report formats for both bench-scale and pilot-scale treatability studies are presented in Table 5-1.

Table 5-1. Treatability Study Report Format
General Site Work Plan
Jacksonville Naval Air Station
Jacksonville, Florida

Bench-Scale Work Plan Format

1.0 Project Description and Site Background

2.0 Remediation Technology Description

3.0 Test Objectives

4.0 Specialized Equipment and Materials

5.0 Laboratory Test Procedures

6.0 Treatability Test Plan Matrix and Parameters To Measure

7.0 Analytical Methods

8.0 Data Management

9.0 Data Analysis and Interpretation

10.0 Health and Safety

11.0 Residuals Management

12.0 Conclusions and Recommendations

Pilot-Scale Work Plan Format

1.0 Project Description and Site Background

2.0 Remediation Technology Description

3.0 Test Objectives

4.0 Pilot Plant Installation and Start-up

5.0 Pilot Plant Operation and Maintenance Procedures

6.0 Parameters to be Tested

7.0 Sampling Plan

8.0 Analytical Methods

9.0 Data Management

10.0 Data Analysis and Interpretation

11.0 Health and Safety

12.0 Residuals Management

13.0 Conclusions and Recommendations

6.0 FEASIBILITY STUDY TASKS

The following tasks identify the work necessary for the FS. The results of the RI and the Baseline Risk Assessment are the basis for establishing remedial action objectives prior to identifying applicable remedial action technologies, developing remedial alternatives and screening remedial alternatives. The following sections highlight the components of an FS, specifically: (1) identification of ARARs, (2) development and screening of alternatives, and (3) detailed analysis of remedial action alternatives and development of the FS report.

6.1 ARARs Identification

Following the risk assessment, Applicable or Relevant and Appropriate Requirements (ARARs) are identified for the contaminants of concern. ARARs are defined in the Feasibility Study for: (1) specific chemicals in the respective contaminated media; (2) location specific requirements; and (3) action specific requirements.

6.1.1 Definition

ARARs were designated by the EPA to be protective of human health and the environment. Section 121 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) (EPA, 1988f) specifies that remedial actions must attain a general standard of cleanup that assures protection of human health and the environment. In addition, for any material remaining on-site, the concentration level or standard of control that must be met for either the hazardous substance, pollutant, or contaminant should be at least that of any applicable or relevant and appropriate standard, requirement, criteria, or limitation under federal environmental law or more stringent standard, requirement, criteria, or limitation promulgated by a state environmental

statute. An environmental requirement (regulation), under environmental laws such as the Resource Conservation and Recovery Act (RCRA), the Safe Drinking Water Act (SDWA), and the Clean Water Act (CWA), may be either applicable or relevant and appropriate. Identification of ARARs can be made only on an OU-specific basis. They depend on the specific chemicals detected at an OU, the particular actions proposed as a remedy, and the individual OU characteristics.

6.1.1.1 Applicable Requirements. Applicable requirements are defined as: "cleanup standards, standards of control, and other substantive environmental protection requirements, criteria or limitations promulgated under Federal or State law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location or other circumstance...." (52 FR 166). Applicability implies that the remedial action or the circumstances at the OU satisfy all of the jurisdictional prerequisites of a requirement (52 FR 166).

6.1.1.2 Relevant and Appropriate Requirements. Relevant and Appropriate requirements are defined as: "cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or state law that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site." (52 FR 166).

ARARs may set protective cleanup levels for the chemicals of concern in specific media, or indicate an acceptable level of discharge where one occurs in a remedial activity. Once it is determined that a requirement is both relevant and appropriate, such requirements must be complied with to the same degree as if it were applicable. It is possible, however, that only part of a

relevant and appropriate requirement is considered relevant and appropriate with the rest dismissed as not relevant to the case in question.

6.1.2 Types of ARARs

There are three types of ARARs: chemical-, location-, and action-specific. Chemical-specific ARARs are health or risk-based numerical values or methodologies that establish acceptable amounts or concentrations of a chemical that may be found in or discharged to the ambient environment. A limited number of chemical-specific ARARs are available; however, if more than one requirement exists for a chemical, the more stringent requirement is generally used. Using the chemical-specific requirements established in the risk assessment, risk calculations are carried out to establish cleanup goals. The chemical-specific requirements may set protective cleanup levels for the chemicals of concern in the designated media or indicate an acceptable level of discharge (52 FR 166).

EPA usually sets chemical-specific requirements for a single chemical or class of chemicals, not a mixture. As a result, characteristics at a specific OU may make the chemical-specific requirements inadequate to protect human health and the environment and cleanup goals may be set below the chemical-specific ARARs. There are no chemical-specific ARARs per se for soil, either at the federal or state level. Some chemical-specific requirements for ground water and surface water are: RCRA Maximum Concentration Limits (RCRA MCLs), Maximum Contaminant Levels (MCLs), in public drinking water systems; MCL goals (MCLGs), nonenforceable health goals for public water supply systems; Federal Water Quality Criteria (FWQC), and National Ambient Air Quality Standards (NAAQS). MCLGs are potentially relevant and appropriate standards under CERCLA 121 and FWQC can be relevant and appropriate in specific cases considering the designated and/or potential use of the water and media affected.

Location-specific ARARs set restrictions on the concentrations of hazardous substances or performance of activities solely because they are in specific locations, e.g., flood plains, wetlands, historic places, sensitive ecosystems. These requirements may restrict alternative remedial actions due to the characteristics of the specific OU. Location-specific ARARs can be found in the following: RCRA, National Historic Preservation Act, Endangered Species Act, National Register of Historic Places, Wilderness Act, Fish and Wildlife Coordination Act, Wild and Scenic River Act, Coastal Zone Management Act, and CWA.

Action-specific ARARs are generally technology- or activity-based requirements or limitations on actions taken with hazardous wastes. Action-specific ARARs are numerous because they are elicited by the remedial activities selected and there is a wide range of possible remedial alternatives. These ARARs do not determine the alternative but instead set controls and restrictions on activities related to management of contaminants. RCRA incineration standards, RCRA regulations for closure of hazardous waste storage or disposal units, and the CWA pretreatment standards contain action-specific ARARs.

6.1.3 ARARs Identification and Utilization

ARARs are identified on an OU-specific basis depending on the chemicals present at the OU, the OU characteristics, and the actions proposed as a remedy. The ARARs provide a measure of the acceptability of remedial actions as well as a means to define whether residual wastes are present in hazardous amounts.

6.1.3.1 Identifying State ARARs. As mandated by CERCLA 121, remedies must comply with any promulgated standard, requirement, criteria, or limitation under a state environmental or facility siting law that is more stringent than any Federal standard, requirement, criteria, or limitation, if the former is

applicable or relevant and appropriate to the hazardous substance or release in question (52 FR 166). If a state has a promulgated water quality standard for a given chemical and use, the state standard should be used instead of a water-quality criteria, because it represents an OU-specific adaptation of a water quality criteria. If a state has not designated uses for a surface water, whether a water-quality criteria is relevant and appropriate should be based on a site-specific decision about current and potential uses of the water body.

6.1.3.2 When and Where ARARs Should Be Attained. The identification and consideration of ARARs should occur several times in the remedial planning process. During the RI/FS scoping process, preliminary identification of chemical- and location-specific ARARs is performed. Chemical- and location-specific ARARs should be more fully identified during the OU characterization phase of the RI, and used to aid in determination of cleanup goals. During development of remedial alternatives in the FS, action-specific ARARs for each proposed alternative will be prepared. Selection of the most appropriate remedial alternative, in fact, is dependent on its ability to attain all ARARs unless a waiver is invoked. Finally, technical specifications of construction during remedial design must assure ARAR achievement. At a minimum, chemical- and location-specific ARARs should be identified after OU characterization, and action-specific ARARs should be identified after initial screening of alternatives (prior to detailed analysis) for alternatives that pass through the screening (52 FR 166).

Attainment of ARARs must occur at all potential exposure points to ensure protection of human health. At an OU where an exposure point is not specified, the Navy and its contractors must use professional judgement to determine, using a RME scenario, where the ARAR is to be attained. In general, on-site actions need only comply with the substantive aspects of ARARs, not with the

corresponding administrative requirements, (CERCLA 121), i.e., activities may proceed without obtaining permits. CERCLA defines on-site as the areal extent of contamination and all suitable areas in very close proximity to the contamination necessary for implementation of the response action. It is important to note that off-site remedies, those remedies which involve waste transport outside of the NAS Site, for Superfund cleanups must obtain all permits necessary and comply with the substantive requirements that permits enforce.

During removal and/or emergency response type actions, the Navy and its contractors should comply with ARARs to the extent practicable. The following three factors are important when deciding if ARAR attainment is possible: the current situation, the scope of the removal action to be taken, and the effect of ARAR attainment of the statutory limits for removal action and costs.

6.1.4 Determination of Whether a Requirement is Appropriate

ARARs include promulgated requirements or laws imposed by legislative bodies and regulations developed by agencies that are of general applicability and are legally enforceable. Some considerations that may be important in determining whether a requirement is appropriate include: the requirement's purpose, the OU's physical characteristics and contamination, the substances covered by the requirement, duration of the activity, the basis for a waiver or exemption, and whether another requirement is available that is more suited to circumstances at the site.

In some cases, more than one ARAR exists for a given chemical. The decision as to which ARAR takes precedence (usually the more stringent ARAR), is made by the EPA in cooperation with other agencies such as the state, National Oceanic and Atmospheric Administration (NOAA), ATSDR, etc. Non-promulgated advisories or guidance documents issued by federal or state governments, as well

as standards that are not of general application, do not have the status of potential ARARs. However, these guidance documents may still be considered in determining an appropriate, protective remedy. In the absence of ARARs, values lower in the hierarchy such as health advisories, state advisories, proposed MCLGs, and RfD-based drinking-water criteria can be used to aid in determination of the necessary level of cleanup for protection of human health or environment; however, these values lend some room for negotiation.

6.1.5 Identification of ARARs

As additional data pertaining to the OU become available, the list of new ARARs will increase and the existing list will need to be refined. The decision process for ARAR identification is broken down into five steps: (1) identify potential ARARs into chemical-, location-, and action-specific requirements using site characterization data; (2) analyze potential ARARs to determine whether they are actually applicable at the OU; (3) if requirements are not applicable, then analyze to determine whether they are relevant and appropriate at the OU; (4) use of criteria, guidances, advisories, and proposed standards may be used to supplement ARARs in development of the OU risk assessment; and (5) determine if a waiver of any ARARs is justified.

If new ARARs based on new scientific information are developed after remediation has begun, the Navy will consider them as part of the ARAR review. This is conducted every five years to ensure that the remedy is still protective under CERCLA 121 for OUs where hazardous wastes remain onsite.

6.1.6 Determination of Applicability

The Navy and its contractors should determine the applicability of a potential ARAR. An applicable requirement directly and fully addresses or regulates the hazardous substance, pollutant, contaminant, action being taken, or other circumstance at the OU. Applicability is established by the terms of the laws and regulations promulgating the requirements being analyzed. All jurisdictional prerequisites must be met for the requirement to be applicable. These requirements are the following: who, as specified by the statute or regulation, is subject to its authority; the types of substances or activities listed as falling under the authority of the statute or regulation; the time period for which the statute or regulation is in effect; the types of activities the statute or regulation requires, limits, or prohibits. The Navy should carefully examine the language of each requirement needs to determine whether the requirement legally applies to the OU or response action.

6.1.7 Determination of Relevance and Appropriateness

If the Navy and its contractors and EPA do not deem a requirement applicable, then it may be relevant and appropriate. A requirement is relevant and appropriate if it regulates or addresses problems or situations sufficiently similar to those at the OU, and is appropriate to the circumstances of the release or threatened release such that its use is well suited to the OU. Determination of relevance and appropriateness of a requirement is OU-specific and the Navy and EPA must base this determination on professional judgement. They will base their judgement on the characteristics of the remedial action, the OU physical characteristics, the hazardous substances present, and the release as compared to the regulatory requirements.

Two steps are involved in determining relevance and appropriateness: first, the Navy and its contractors and EPA must find the requirement relevant; second, they must ascertain the appropriateness of the requirement to the OU. They also must consider the following factors when determining relevance: goals and objectives of the requirement; original purpose of the requirement; media affected by the requirement; substances covered by the requirement; variances, waivers, or exemptions of the requirement; type of physical location regulated; type of facility regulated; and the requirements evaluation of use or potential use of affected resource.

The following factors are important when determining how appropriate the requirement is for the situation: specific goals of OU remedial action; purpose for using requirements at the OU; media affected by cleanup; hazardous substances involved; remedial action considered and its duration; OU circumstances (i.e., is a waiver, variance, or exception necessary?); type of physical location; type of facility; and use or potential use of resource involved. A requirement may be relevant because it addresses conditions similar to those at the OU on some of the factors listed above, but not appropriate because OU conditions differ significantly on other key factors. Professional judgement is important when determining whether a requirement is both relevant and appropriate. Once the determination of relevance and appropriateness is made, the requirement must be complied with as if it were applicable.

6.1.8 ARAR Waiver Procedures

CERCLA 121 allows an ARAR to be waived under certain circumstances, provided that protection of human health and environment is assured. (USEPA, 1988f). These waivers only apply to on-site attainment of ARARs during remedial actions; ARAR compliance at off-site exposure points cannot be waived. The Navy must request a waiver for each ARAR that will not be met or will be

exceeded. The six circumstances under which waivers may be requested are as follows: (1) Interim Measures: the remedial action is part of the total site remediation planned and complete measures to attain ARARs will follow in a reasonable time frame; (2) Greater Risk To Health and the Environment: attainment of an ARAR(s) will result in greater risks to human health and the environment than alternate options(s); (3) Technical Impracticability: ARAR compliance is technically impracticable from an engineering perspective; (4) Equivalent Standard of Performance: remedial action selected will attain a standard of performance equal to that required by the ARAR through use of another approach; (5) Inconsistent Application of State Requirements: the state has not consistently applied the ARAR at other remedial actions under similar circumstances; and (6) Fund Balancing: attainment of an ARAR would incur costs out of proportion in relation to the degree of reduction of risk.

The technical impracticability waiver has two criteria that must be met: engineering feasibility - the current engineering methods necessary to meet the ARAR cannot be reasonably implemented; and reliability - the potential for the alternative to be protective into the future is low, either because of unreliable control measures or inordinate costs. The Navy cannot use the inconsistent application of state requirements waiver if the state involved has demonstrated the intention to consistently apply the requirement.

6.1.9 Specific ARARs

Table 6-1 presents federal and state requirements which may be applied as chemical-, action-, or location-specific ARARs. The TBCs on Table 6-1 include other guidance concentrations which are not legally enforceable. CERCLA Regulations reference life-time health advisories, RfD-based drinking water criteria, and FWQC as TBC guidelines. The Navy, in accordance with CERCLA regulations,

TABLE 6-1.

Examples of Potential Federal and State ARARs and TBCs

I. Federal requirements which may be potential applicable or relevant and appropriate requirements.

i. EPA's Office of Solid Waste administers, inter alia, the Resource Conservation and Recovery Act of 1976, as amended, (42 U.S.C. 6901). Potentially applicable or relevant and appropriate requirements pursuant to that Act are:

a. Open Dump Criteria – Pursuant to RCRA Subtitle D for classification of solid waste disposal facilities (40 *CFR* Part 257). Note: Only relevant to nonhazardous wastes.

b. RCRA Subtitle C requirements governing standards for owners and operators of hazardous waste treatment, storage, and disposal facilities (40 *CFR* Part 264, for permitted facilities, and 40 *CFR* Part 265, for interim status facilities):

(1) Ground-Water Protection and Monitoring (40 *CFR* 264.90-264.109).

(2) Closure and Post Closure (40 *CFR* 264.110-264.120).

(3) Containers (40 *CFR* 264.170-264.178).

(4) Tanks (40 *CFR* 264.190-264.199).

(5) Surface Impoundments (40 *CFR* 264.220-264.249).

(6) Waste Piles (40 *CFR* 264.250-264.269).

(7) Land Treatment (40 *CFR* 264.270-264.299).

(8) Landfills (40 *CFR* 264.300-264.339).

(9) Incinerators (40 *CFR* 264.340-264.999).

(10) Land Disposal Restrictions (40 *CFR* 268.1-268.50).

(11) Dioxin-containing wastes (50 *FR* 1978).

(12) Standards of performance for storage vessels for petroleum liquids [40 *CFR* Part 60, Subparts K and K(a)].

(13) Codification rule for 1984 RCRA amendments (50 *FR* 28702, July 15, 1985; 53 *FR* 45788, December 1, 1987).

ii. EPA's Office of Water administers several potentially applicable or relevant and appropriate statutes and regulations issued thereunder:

a. Section 14.2 of the Public Health Service Act as amended by the Safe Drinking Water Act, as amended, [42 U.S.C. 300(f)].

(1) Maximum Contaminant Levels (for all sources of drinking water exposure) (40 *CFR* 141.11-141.16).

(2) Maximum Contaminant Level Goals (40 *CFR* 141.50-141.52, 50 *FR* 46936).

(3) Underground Injection Control Regulations (40 *CFR* Parts 144, 145, 146, 147).

b. Clean Water Act, as amended; (33 U.S.C. 1251).

(1) Requirements established pursuant to sections 301, 302, 303 (including state water quality standards), 304, 306, 307 (including federal pretreatment requirements for discharge into a publicly owned treatment works), 308, 402, 403 and 404 of the Clean Water Act (33 *CFR* Parts 320-330, 40 *CFR* Parts 122, 123, 125, 131, 230, 231, 233, 400-469).

(2) Available federal water quality criteria documents are listed at 45 *FR* 79318, November 28, 1980; 49 *FR* 5831, February 15, 1984; 50 *FR* 30784, July 29, 1985; 51 *FR* 8012, March 7, 1986; 51 *FR* 22978, June 28, 1986; 51 *FR* 43665, December 3, 1986; 52 *FR* 6213, March 2, 1987; 53 *FR* 177, January 5, 1988; 53 *FR* 19028, May 26, 1988; 53 *FR* 33177, August 30, 1988; 54 *FR* 19227, May 4, 1989.

(3) Clean Water Act section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material (40 *CFR* Part 230).

(4) Procedures for Denial or Restriction of Disposal Sites for Dredged Material [Clean Water Act section 404(c) Procedures, 33 *CFR* Parts 320-329, 40 *CFR* Part 231].

c. Marine Protection, Research, and Sanctuaries Act (33 U.S.C. 1401).

(1) Incineration at sea requirements (40 *CFR* Parts 220-225, 227-229. See also 40 *CFR* 125.120-125.124).

iii. EPA's Office of Pesticides and Toxic Substances administers the Toxic Substances Control Act (15 U.S.C. 2601). Potentially applicable or relevant and appropriate requirements pursuant to that Act are:

PCB requirements generally: 40 *CFR* Part 761; Manufacturing, Processing, Distribution in Commerce, and Use of PCBs and PCB Items (40 *CFR* 761.20-761.30); Markings of PCBs and PCB Items (40 *CFR* 761.40-761.45); Storage and Disposal (40 *CFR* 761.60-761.79); Records and Reports (40 *CFR* 761.180-761.185, 761.187 and 761.193). See also 40 *CFR* 129.105, 750.

iv. EPA's Office of External Affairs administers potentially applicable or relevant and appropriate requirements regarding requirements for floodplains and wetlands (40 *CFR* Part 6, Appendix A)

Source: Hazardous Waste Consultant, May/June 1990

TABLE 6-1.
(Continued)

Examples of Potential Federal and State ARARs and TBCs

v. EPA's Office of Air and Radiation administers several potentially applicable or relevant and appropriate statutes and regulations issued thereunder:

a. The Uranium Mill Tailings Radiation Control Act of 1978 (42 U.S.C. 2022) and Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings (40 *CFR* Part 192).

b. Clean Air Act (42 U.S.C. 7401).

(1)National Primary and Secondary Ambient Air Quality Standards (40 *CFR* Part 50).

(2) Standards for Protection Against Radiation (10 *CFR* Part 20). See also 10 *CFR* Parts 10, 40, 60, 61, 72, 960, 961.

(3) National Emission Standards for Hazardous Air Pollutants (40 *CFR* Part 61). See also 40 *CFR* 427.110-427.116, 763.

(4) New source performance standards (40 *CFR* Part 60).

vi. Other federal requirements:

a. National Historic Preservation Act (16 U.S.C. 470). Compliance with NHPA required pursuant to 7 *CFR* Part 650. Protection of Archaeological Resources: Uniform Regulations – Department of Defense (32 *CFR* Part 229), Department of the Interior (43 *CFR* Part 7).

b. DOT Rules for the Transportation of Hazardous Materials, 49 *CFR* Parts 107, 171, 172.

c. The following requirements are also potentially ARARs for Fund-financed actions:

(1) Endangered Species Act of 1973 (16 U.S.C. 1531). Generally, 50 *CFR* Parts 81, 225, 402.

(2) Wild and Scenic Rivers Act (16 U.S.C. 1271).

(3) Fish and Wildlife Coordination Act (16 U.S.C. 661).

(4) Federal Insecticide, Fungicide, and Rodenticide Act (7 U.S.C. 136) 40 *CFR* Part 165.

(5) Wilderness Act (16 U.S.C. 1131).

(6) Coastal Barriers Resources Act (16 U.S.C. 3501).

(7) Surface Mining Control and Reclamation Act (30 U.S.C. 1201).

(8) Coastal Zone Management Act of 1972 (16 U.S.C. 1451). Generally, 15 *CFR* Part 930 and 15 *CFR* 923.45 for Air and Water Pollution Control Requirements.

(9) Magnuson Fishery Conservation and Management Act (16 U.S.C. 1801 et seq.).

(10) Marine Mammal Protection Act (16 U.S.C. 1361 et seq.).

2. *Examples of potential state ARARs.*

i. State requirements for disposal and transport of radioactive wastes.

ii. State approval of water supply system additions or developments.

iii. State ground-water withdrawal approvals.

iv. Requirements of authorized (Subtitle C of RCRA) state hazardous waste programs.

v. State Implementation Plans (SIPs) and delegated programs under the Clean Air Act.

vi. Approved state NPDES programs under the Clean Water Act.

vii. Approved state underground injection control (UIC) programs under the Safe Drinking Water Act.

viii. Approved state wellhead protection programs.

ix. State water quality standards.

x. State air toxics regulations.

3. *Other Federal criteria, advisories, and guidance, to be considered (TBC).*

i. Federal criteria, advisories, and procedures.

a. Health Effects Assessments (HEAs) and Proposed HEAs ("Health Effects Assessment Summary Tables," updated quarterly).

b. Reference Doses (RfDs) ["Health Effects Assessment Summary Tables," updated quarterly, or "Integrated Risk Information System (IRIS)," updated monthly].

c. Slope Factors for Carcinogens ["Health Effects Assessment Summary Tables," updated quarterly, or "Integrated Risk Information System (IRIS)," updated monthly].

d. Pesticide registrations and registration data.

e. Pesticide and food additive tolerances and action levels. Note: Germane portions of tolerances and action levels may be pertinent and therefore are to be considered in certain situations.

f. PCB Spill Cleanup Policy (52 *FR* 10688, April 2, 1987).

g. Waste load allocation procedures (40 *CFR* Parts 125, 130).

Source: Hazardous Waste Consultant, May/June 1990

TABLE 6-1.
(Continued)

Examples of Potential Federal and State ARARs and TBCs

h. Federal sole source aquifer requirements (52 *FR* 6873. March 5, 1987).
i. Public health basis for the decision to list pollutants as hazardous under section 112 of the Clean Air Act.
j. EPA's Ground-Water Protection Strategy.
k. Guidance on Remedial Actions for Contaminated Ground Water at Superfund Sites (Draft. October 1986) establishes criteria for the use of background concentrations and ACLs.
l. Superfund Public Health Evaluation Manual.
m. TSCA health data.
n. TSCA chemical advisories.
o. ATSDR Toxicological Profiles.
p. Advisories issued by FWS and NWFS under the Fish and Wildlife Coordination Act.
q. TSCA Compliance Program Policy ("TSCA Enforcement Guidance Manual Policy Compendium." USEPA, OECM, OPTS, March 1985).
r. Health Advisories, EPA Office of Water.
s. EPA/DOT Guidance Manual on Hazardous Waste Transportation.

ii. USEPA RCRA Guidance Documents.
a. Alternate Concentration Limits (ACL). Guidance (draft).
b. EPA's RCRA Design Guidelines
(1) Surface Impoundments – Liner Systems, Final Cover, and Freeboard Control.
(2) Waste Pile Design – Liner Systems.
(3) Land Treatment Units.
(4) Landfill Design – Liner Systems and Final Cover.
c. Permitting Guidance Manuals.
(1) Permit Applicant's Guidance Manual for Hazardous Waste Land Treatment, Storage, and Disposal Facilities.
(2) Permit Applicant's Guidance Manual for the General Facility Standards of 40 *CFR* Part 264.
(3) Permit Writer's Guidance Manual for Hazardous Waste Land Treatment, Storage, and Disposal Facilities.
(4) Permit Writer's Guidance Manual for the Location of Hazardous Waste Land Storage and Disposal Facilities: Phase I, Criteria for Location Acceptability and Existing Regulations for Evaluating Locations.
(5) Permit Writer's Guidance Manual for Subpart F.
(6) Permit Applicant's Guidance Manual for the General Facility Standards.
(7) Waste Analysis Plan Guidance Manual.
(8) Permit Writer's Guidance Manual for Hazardous Waste Tanks.
(9) Model Permit Application for Existing Incinerators.
(10) Guidance Manual for Evaluating Permit Applications for the Operation of Hazardous Waste Incinerator Units.
(11) A Guide for Preparing RCRA Permit Applications for Existing Storage Facilities.
(12) Guidance Manual on Closure and Post-Closure Interim Status Standards.
d. Technical Resource Documents (TRDs).
(1) RCRA Ground-Water Monitoring Technical Enforcement Guidance Document.
(2) Evaluating Cover Systems for Solid and Hazardous Waste.
(3) Hydrologic Simulation of Solid Waste Disposal Sites.
(4) Landfill and Surface Impoundment Performance Evaluation.
(5) Lining of Water Impoundment and Disposal Facilities.
(6) Management of Hazardous Waste Leachate.
(7) Guide to the Disposal of Chemically Stabilized and Solidified Waste.
(8) Closure of Hazardous Waste Surface Impoundments.
(9) Hazardous Waste Land Treatment.
(10) Soil Properties, Classification, and Hydraulic Conductivity Testing.
e. Test Methods for Evaluating Solid Waste.
(1) Solid Waste Leaching Procedure Manual.
(2) Methods for the Prediction of Leachate Plume Migration and Mixing.
(3) Hydrologic Evaluation of Landfill Performance (HELP) Model Hydrologic Simulation and Solid Waste Disposal Sites.
(4) Procedures for Modeling Flow Through Clay Liners to Determine Required Liner Thickness.
(5) Test Methods for Evaluating Solid Wastes.
(6) A Method for Determining the Compatibility of Hazardous Wastes.
(7) Guidance Manual on Hazardous Waste Compatibility.

Source: Hazardous Waste Consultant, May/June 1990

TABLE 6-1.
(Continued)

Examples of Potential Federal and State ARARs and TBCs

iii. USEPA Office of Water Guidance Documents.
- a. Pretreatment Guidance Documents.
  - (1) 304(g) Guidance Document on Revised Pretreatment Guidelines (3 volumes).
- b. Water Quality Guidance Documents.
  - (1) Ecological Evaluation of Proposed Discharge of Dredged Material into Ocean Waters (1977).
  - (2) Technical Support Manual: Waterbody Surveys and Assessments for Conducting Use Attainability Analyses (1983).
  - (3) Water-Related Environmental Fate of 129 Priority Pollutants (1979).
  - (4) Water Quality Standards Handbook (1983).
  - (5) Technical Support Document for Water-Quality-Based Toxics Control.
  - (6) Developing Requirements for Direct and Indirect Discharges of CERCLA Wastewater (1987).
- c. NPDES Guidance Documents.
  - (1) NPDES Best Management Practices Guidance Manual (June 1981).
  - (2) Case studies on toxicity reduction evaluation (May 1983).
- d. Ground Water/UIC Guidance Documents.
  - (1) Designation of a USDW.
  - (2) Elements of Aquifer Identification.
  - (3) Definition of major facilities.
  - (4) Corrective action requirements.
  - (5) Requirements applicable to wells injecting into, through, or above an aquifer that has been exempted pursuant to 40 *CFR* 146.104(b)(4).
  - (6) Guidance for UIC Implementation on Indian lands.
- e. Clean Water Act Guidance Documents.
- f. Guidance for Applicants for State Well Head Protection Program Assistance Funds under the Safe Drinking Water Act (Office of Ground-Water Protection, June 1987).

iv. USEPA Manuals from the Office of Research and Development.
- a. EW 846 methods—laboratory analytic methods.
- b. Lab protocols developed pursuant to Clean Water Act section 304(h).

v. Other
- a. Data Quality Objectives, Volumes I and II.
- b. Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (Draft).
- c. Guidance on Preparing Superfund Decision Document: The Proposed Plan and Record of Decision (Draft).
- d. Standard Operating Safety Guides.

Source: Hazardous Waste Consultant, May/June 1990

may consider these advisories and guidance documents, along with others, in determining the necessary level of cleanup protection of either human health or the environment.

6.2 Development and Screening of Alternatives

Development and screening of remedial action alternatives will be conducted in conformance with the National Oil and Hazardous Substance Pollution Contingency Plan (NCP), CERCLA, and the Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, EPA OSWER Directive Number 9355.3-01, October 1988, or the most recent guidance. Development and screening of alternatives includes:

1) Establishment of remedial action objectives;

2) Identification and screening of remedial technologies;

3) Assembly of potential remedial alternatives; and

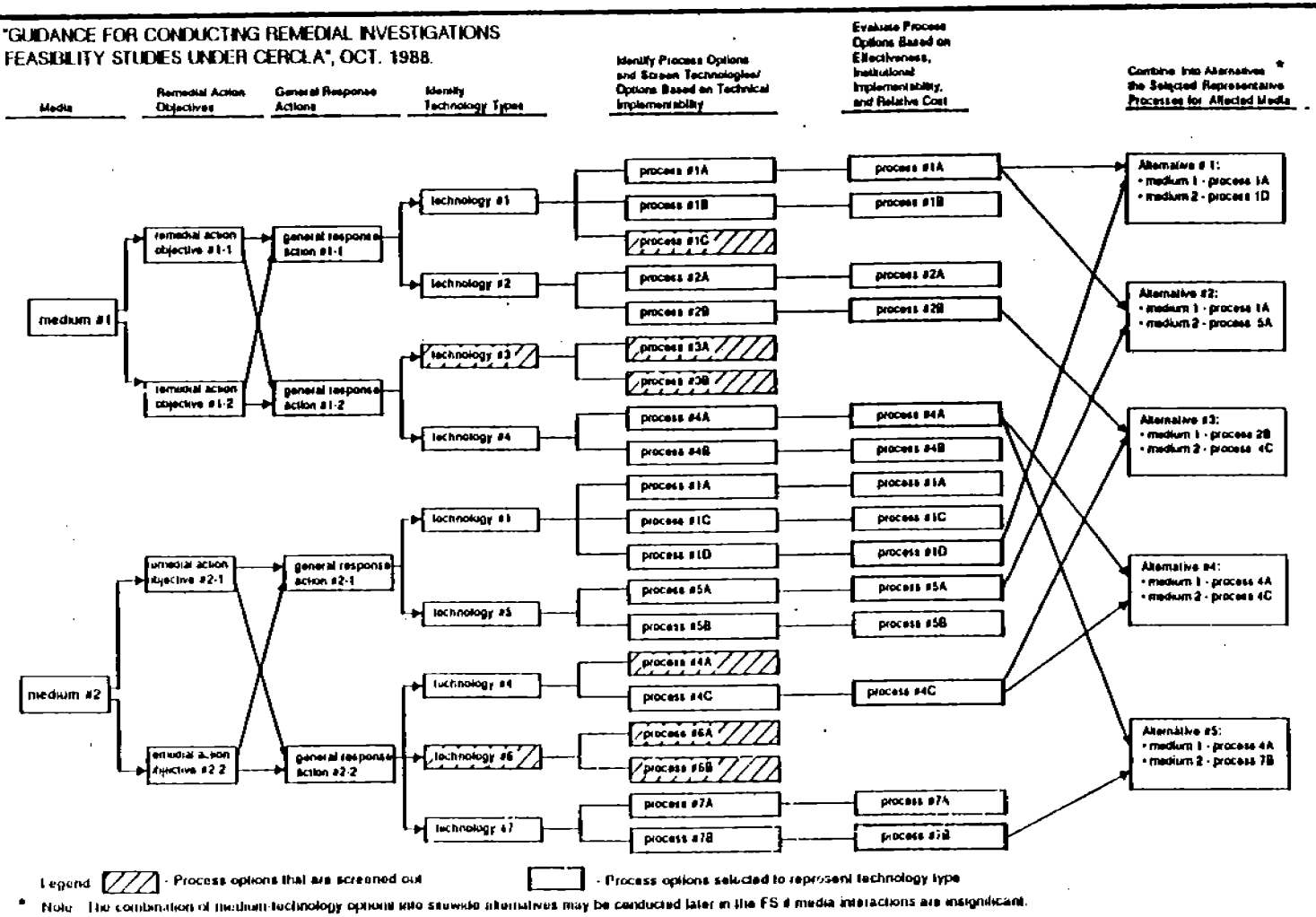
4) Initial screening of alternatives.

The generic alternative development process is presented in Figure 6-1. The process includes delineating the media and constituents of concern at the OU, developing remedial action objectives for the OU, identifying general response actions to attain the remedial action objectives, selecting technologies and process options based on implementability, effectiveness and relative cost to implement the general response actions and combining these technologies and process components into remedial action alternatives.

6.3 Establishment of Remedial Action Objectives

Remedial action objectives will be developed to conform to the results of the Baseline Risk Assessment. Cleanup levels will be

SOURCE: EPA "GUIDANCE FOR CONDUCTING REMEDIAL INVESTIGATIONS AND FEASIBILITY STUDIES UNDER CERCLA", OCT. 1988.



GENERIC ALTERNATIVE DEVELOPMENT PROCESS

FIGURE 6-1

REMEDIAL INVESTIGATION/ FEASIBILITY STUDY WORK AND PROJECT MANAGEMENT PLAN

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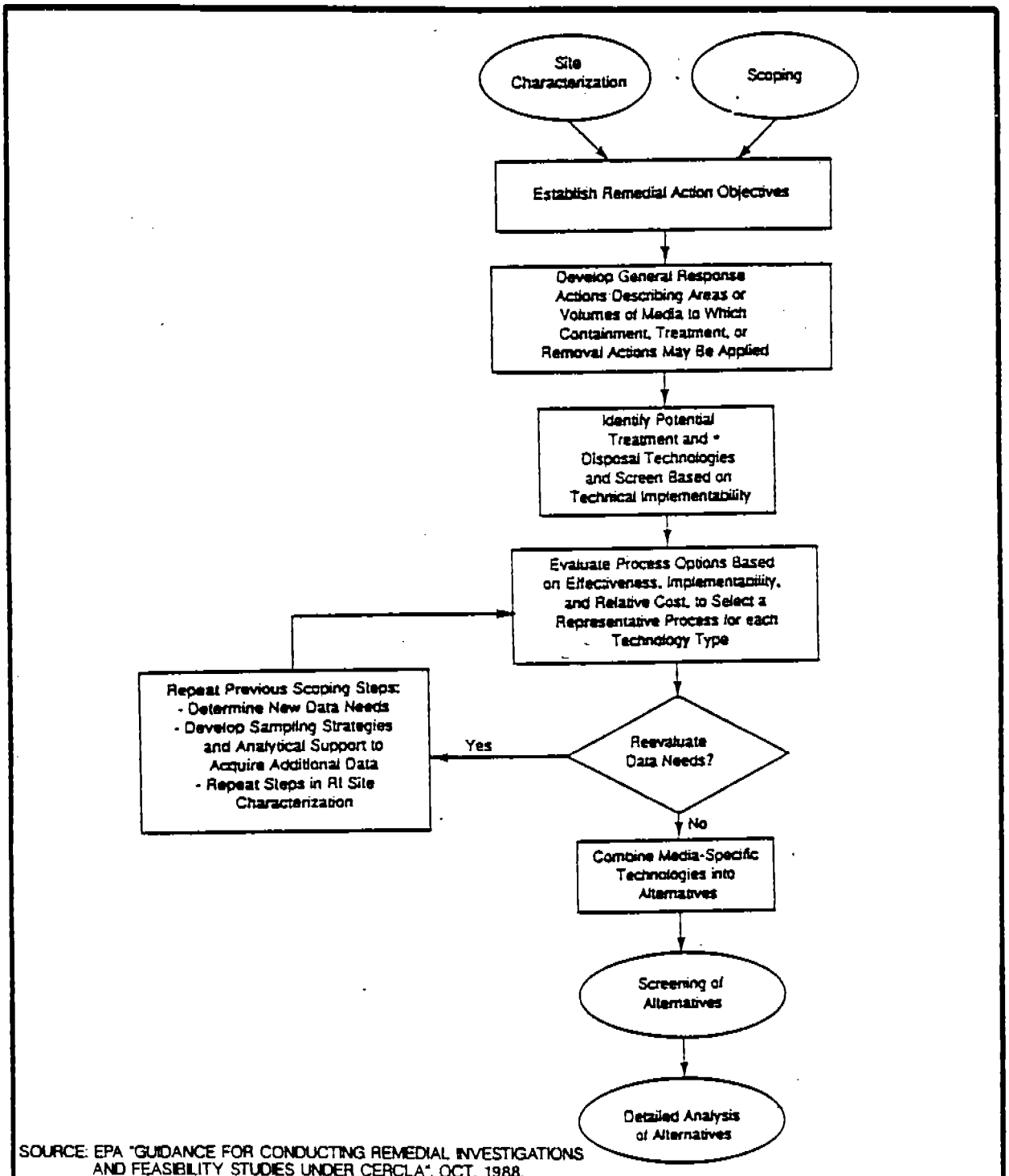
determined by review of the ARARs. Section 121(d) of CERCLA, as amended by SARA, states that remedial actions must assure the protection of human health and the environment, and must comply with Federal and State environmental laws. The Navy and EPA make the assessments regarding applicability of a given statute as an ARAR. Remedial action objectives are developed: (1) for compliance with chemical, action and location-specific ARARs, (2) for specific media, and (3) for physical constraints.

6.4 Identification and Screening of Remedial Technologies

The identification and screening of remedial technologies will be based on OU physical characteristics, contaminant sources, and migration pathways. The steps for remedial technology identification include identification of general response actions which address remedial action objectives and technology and associated process option identification for implementation of general response actions. General response actions may include treatment, containment, extraction, excavation, disposal, institutional actions or a combination of actions. The Navy will describe and prescreen identified treatment and containment technologies based on their implementability, effectiveness, and cost as described in the RI/FS Guidance Document.

6.5 Assembly of Potential Remedial Action Alternatives

The typical process for developing remedial action alternatives is summarized in Figure 6-2. Technologies considered to be implementable, effective, and not cost prohibitive are assembled into remedial alternatives that specifically address the remedial action objectives. Alternatives will include technologies specific to the treatment and/or containment of the waste, the management of remedial action residues and waste streams. Developed alternatives are defined by the size and configuration of



SOURCE: EPA "GUIDANCE FOR CONDUCTING REMEDIAL INVESTIGATIONS AND FEASIBILITY STUDIES UNDER CERCLA", OCT. 1988.

ALTERNATIVE DEVELOPMENT

FIGURE 6-2

REMEDIAL INVESTIGATION/ FEASIBILITY STUDY WORK AND PROJECT MANAGEMENT PLAN

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process options, remediation time, flow rates, spatial requirements, disposal distances and requirements, permit requirements, and action-specific ARARs.

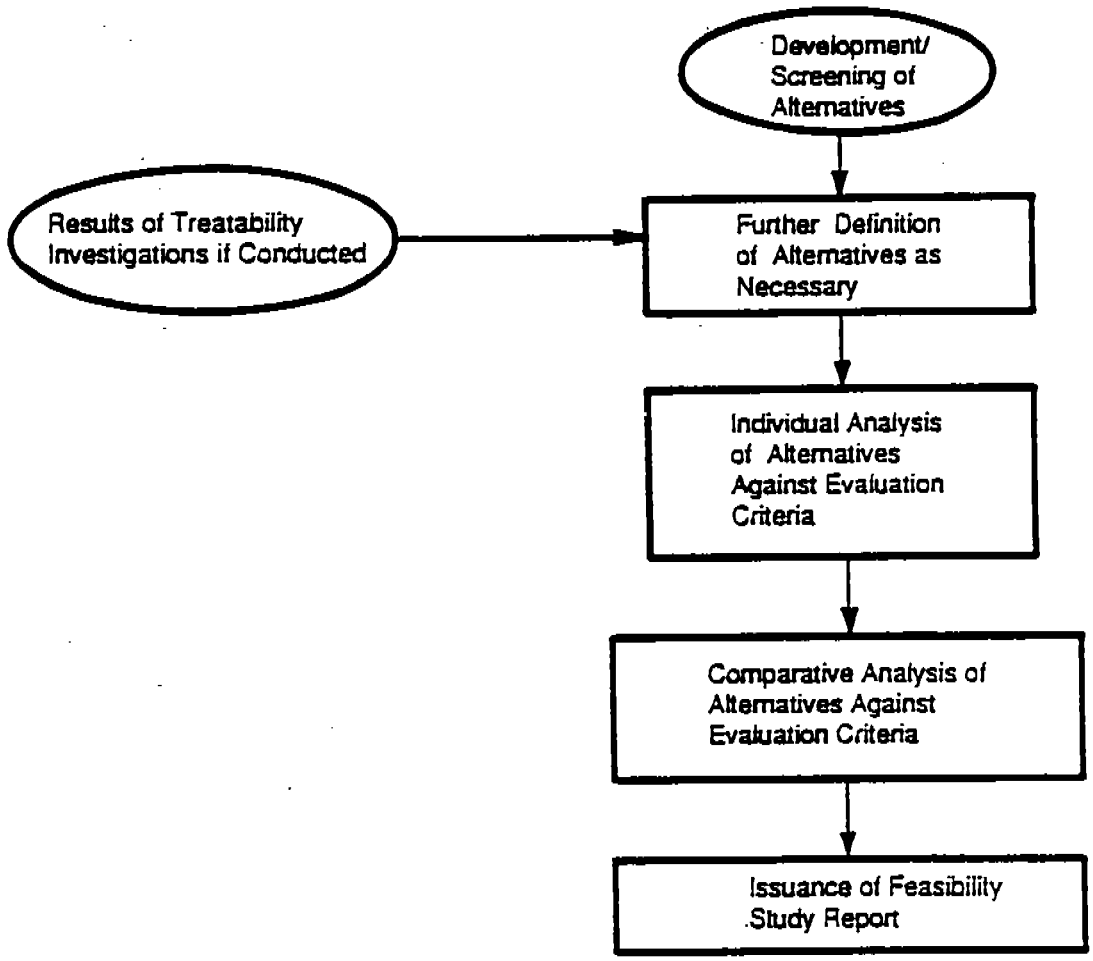
6.6 Initial Screening of Alternatives

To limit the number of alternatives for the detailed analysis, the Navy will screen the alternatives on a general basis for effectiveness, implementability, and relative cost. This screening will take into consideration the identified ARARs for the remedial alternatives.

6.7 Detailed Analysis of Alternatives and Draft Feasibility Study Report

The detailed analysis of alternatives includes further definition of the alternatives, an analysis of the alternatives based on the nine evaluation criteria established by EPA, and a comparison of alternatives with each other. The detailed analysis process is summarized in Figure 6-3. The FS Report will define the technical factors affecting alternative implementation including treatment and/or collection effectiveness, constructability, reliability, and equipment, labor and materials requirements. The report also highlights any special issues such as the use of innovative technology, or lack of disposal capacity.

The detailed analysis includes itemized cost estimates for each alternative. Each cost estimate will include direct and indirect capital and operation and maintenance (O&M) costs, accurate within +50 to -30 percent. Direct capital costs include construction, OU development, utility connections, relocation, and waste disposal. Indirect costs include engineering, permitting and contingencies. Operation and maintenance items may include labor, materials, energy, waste disposal, permit renewals, and equipment replacement.



SOURCE: EPA "GUIDANCE FOR CONDUCTING REMEDIAL INVESTIGATIONS AND FEASIBILITY STUDIES UNDER CERCLA", OCT. 1988.

DETAILED ANALYSIS OF ALTERNATIVES

FIGURE 6-3

REMEDIAL INVESTIGATION/ FEASIBILITY STUDY WORK AND PROJECT MANAGEMENT PLAN

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The nine EPA evaluation criteria for the detailed analysis are:

1) Overall Protection of Human Health and the Environment: Addresses whether or not the remedy provides adequate protection and describes how risks are eliminated, reduced, or controlled.

2) Compliance with ARARs: Addresses whether the alternative would result in compliance with ARARs or if a basis for a waiver from the ARARs is warranted.

3) Long-term Effectiveness and Permanence: Refers to the ability of a remedy to maintain reliable protection of human health and the environment after cleanup goals are met.

4) Reduction of Toxicity, Mobility, or Volume: Evaluates the anticipated performance of treatment technologies.

5) Short-term Effectiveness: Addresses the impacts of alternative implementation on human health and the environment until cleanup goals are met.

6) Implementability: Evaluates the technical and administrative feasibility of implementing an alternative, including the availability of materials and services needed to implement the alternative.

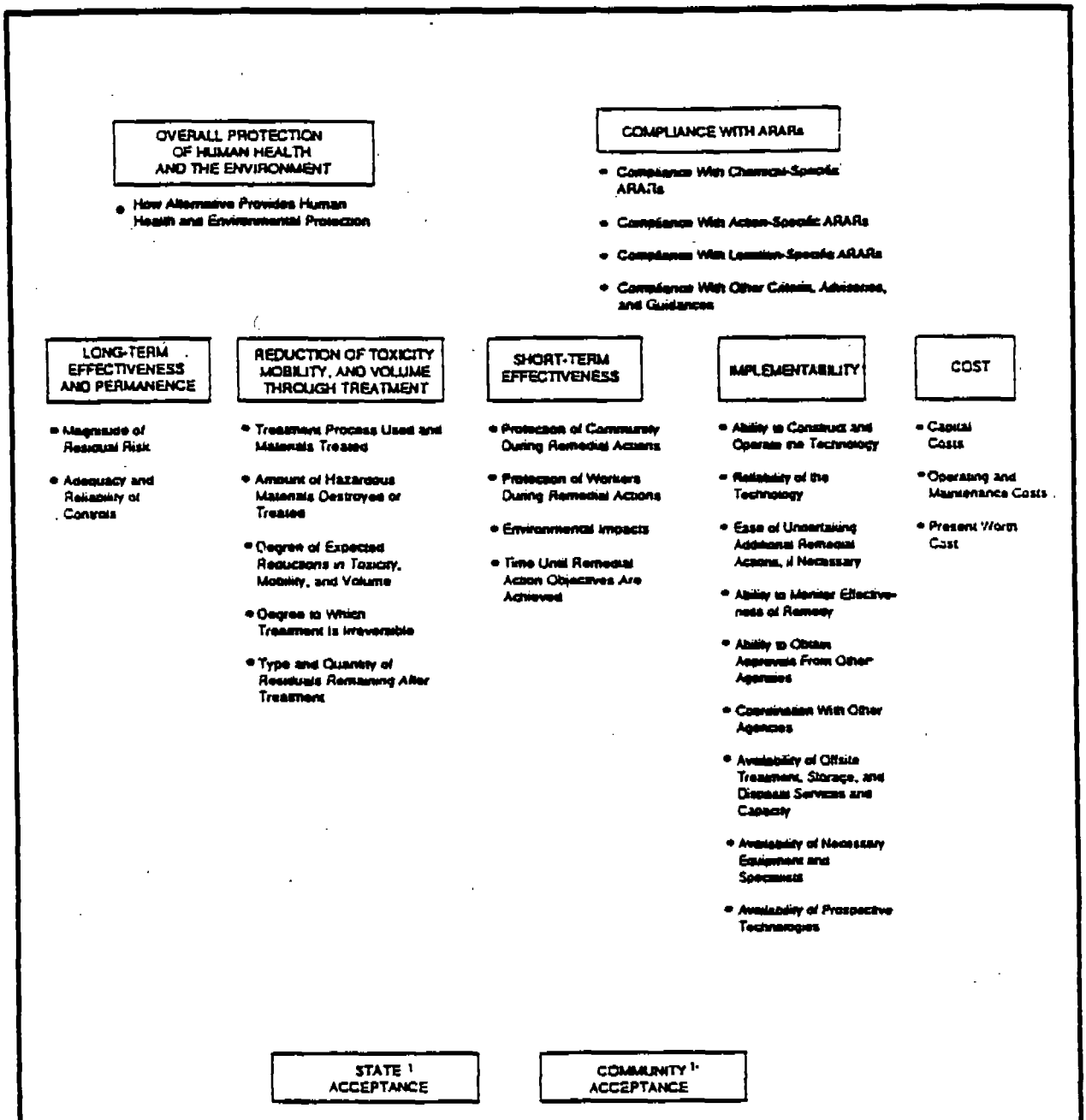
7) Cost: Evaluates the estimated capital and O&M costs, and net present worth of the alternative.

8) State Acceptance: Reviews the preferences and concerns of the support agency.

9) Community Acceptance: Reviews the preferences and concerns of the public.

The criteria for the detailed analysis of the remedial action alternatives is further defined in Figure 6-4.

Following the evaluation of the alternatives for the nine criteria, the Navy and its contractors will compare and contrast the alternatives with one another. The Navy and its contractors will prepare an FS Report that documents the technology screening and alternatives development and analysis process. The proposed report outline is provided in Table 6-2.



[1] These criteria are assessed following comment on the RI/FS report and the proposed plan.

SOURCE: EPA "GUIDANCE FOR CONDUCTING REMEDIAL INVESTIGATION AND FEASIBILITY STUDIES UNDER CERCLA", OCT. 1988.

CRITERIA FOR DETAILED ANALYSIS OF ALTERNATIVES

FIGURE 6-4

REMEDIAL INVESTIGATION/ FEASIBILITY STUDY WORK AND PROJECT MANAGEMENT PLAN

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Table 6-2. Feasibility Study Report Format
General Site Work Plan
Jacksonville Naval Air Station
Jacksonville, Florida

-- Executive Summary

1.0 Introduction

- 1.1 Purpose and Organization of Report
- 1.2 Background Information
  - 1.2.1 OU Description
  - 1.2.2 OU History
  - 1.2.3 Nature and Extent of Contamination
  - 1.2.4 Contaminant Fate and Transport
  - 1.2.5 Baseline Risk Assessment

2.0 Identification and Screening of Technologies

- 2.1 Introduction
- 2.2 Remedial Action Objectives
  - 2.2.1 Contaminants of Interest
  - 2.2.2 Remedial Action Goals
  - 2.2.3 Development of Remediation Goals
- 2.3 General Response Actions
- 2.4 Identification and Screening of Technology Types and Process Options
  - 2.4.1 Identification and Screening of Technologies
  - 2.4.2 Evaluation of Technologies and Selection of Representative Technologies

3.0 Development and Screening of Alternatives

- 3.1 Development of Alternatives
- 3.2 Treatability Study Results
- 3.3 Screening of Alternatives
  - 3.3.1 Introduction
  - 3.3.2 Alternative 1
    - 3.3.2.1 Description
    - 3.3.2.2 Evaluation
  - 3.3.3 Alternative 2
    - 3.3.3.1 Description
    - 3.3.3.2 Evaluation
  - 3.3.4 Alternative 3
    - 3.3.4.1 Desorption
    - 3.3.4.2 Evaluation

Table 6-2. Feasibility Study Report Format
General Site Work Plan
Jacksonville Naval Air Station
Jacksonville, Florida

4.0 Detailed Analysis of Alternatives

- 4.1 Introduction
- 4.2 Individual Analysis of Alternatives
  - 4.2.1 Alternative 1
    - 4.2.1.1 Description
    - 4.2.1.2 Detailed Analysis
  - 4.2.2 Alternative 2
    - 4.2.2.1 Description
    - 4.2.2.2 Detailed Analysis
  - 4.2.3 Alternative 3
    - 4.2.3.1 Desorption
    - 4.2.3.2 Detailed Analysis
- 4.3 Comparative Analysis

Bibliography

Appendices

7.0 QUALITY ASSURANCE/QUALITY CONTROL

Several quality assurance documents have been prepared to ensure the quality of data produced and documents prepared during the implementation of the IRP. These documents include this Basic Site Work Plan, a QA/QC Plan, a Data Analysis Plan, a Final Product Plan and the Basic Sampling and Analysis Plan (BSAP).

The QA/QC Plan is the quality control document for the preparation of the Basic Site Work Plan. This document is included in Appendix 4.1.

The Data Analysis Plan has been prepared as a guidance document for the validation of laboratory data. It includes the step-by-step processes to be implemented to ensure the data is accurate and precise. The Data Analyses Plan is included as Appendix 4.2.

The purpose of the Final Product Plan (Appendix 4.3) is to address validation of the decision process and to identify objectives and ARARs. Also included are guidance for preparing the Final Treatability Studies and RI/FS Reports.

The Basic Sampling and Analysis Plan Appendix 4.4) consists of a Quality Assurance Program Plan (QAPP) (Appendix 4.4.1) and a Basic Field Sampling Plan (BFSP) (Appendix 4.4.2). The objectives of these plans are to specify the methods to be utilized to analyze various environmental samples and the procedures and techniques employed during field investigations, respectively.

8.0 MODELING PROGRAMS

8.1 Objective

Geraghty & Miller, Inc., previous consultant to the Navy, conducted a survey of existing ground-water computer codes to facilitate an analysis of the capabilities of these codes and to provide a basis for their evaluation. The survey affords assessment of their capabilities with regard to its application to site conditions, general input requirements, documentation, availability, and usability. The evaluation also provides recommendations for the selection of modeling application programs for use during the RI/FS process.

8.2 Ground-Water Models

A ground-water model is a simplified representation of a real ground-water system. The term model, for the purposes of this report, is defined as a ground-water flow or transport computer code executed with PSC specific data. The model expresses relationships among components of the system in terms of mathematics, thus simulating system behavior under various conditions. The simulations provide for the prediction of system responses assuming the system parameters and stresses are known. The solution of the mathematical model can be either continuous (analytical) or discrete (numerical) in space and time.

Analytical solutions are those found completely by mathematical analysis. Semi-analytical solutions require numerical techniques for their evaluation, such as integral equations and successive approximation techniques. Approximate analytical solutions do not precisely satisfy the differential equation but the error is assumed to be insignificant. There are several advantages of analytical solutions:

- they are fast, because they are usually exact solutions to the differential equation and there is no iterative procedure for convergence;

- there are no numerical dissipation or damping coefficients required, and there is no numerical dispersion; and

- they are simple and efficient enough to easily run on most microcomputers.

Some of the disadvantages are that the boundary conditions must be regular, and permeability may vary spatially only with strict limitations.

Modelers base numerical solutions on differential equations describing flow or transport. The use of numerical techniques allows for less constraint of application and more flexibility. The survey considered two types of numerical methods of solution: finite difference methods (FD) and finite element methods (FE). For steady-state problems, both methods result in identical difference equations. In either case, a system of nodal points is superimposed over the problem domain and aquifer parameters are assumed to be constant within each node. FD nodes are square or rectangular and can be defined as block-centered or grid-centered. FE nodes can have other geometries, but are usually triangular or quadrilateral. Regardless of the geometric representation, an equation is written for each nodal point and an iterative procedure yields a solution for each node.

Modelers classify ground-water models generally by the physical and chemical processes they describe. Two major processes are ground-water flow or solute transport. Ground-water flow characterize the movement of water in soil or in porous or

fractured media. Solute transport models describe the movement, mixing and chemical reactions of contaminated water with the native water and the soil or rock through which it is flowing.

8.2.1 Ground-water Flow Models

Flow models solve mathematical equations which utilize information on aquifer parameters and boundary conditions for determining quantitative aspects of ground-water flow such as the rate and direction of flow, water-level changes, stream/aquifer interactions, and the drawdown interference effects of pumping wells. Flow models are the most commonly used ground-water models and have undergone considerable development.

8.2.2 Solute-Transport Models

Solute-transport models provide information on ground-water quality. The movement of various constituents, including salt water near coastal areas, can be adequately predicted by these models. To accomplish this, solute-transport models provide mathematical approximations of fluid transport of chemical constituents in ground water.

A solute-transport model generally accounts for three major processes that control the movement and attenuation of constituents in ground water: (1) movement due to ground-water flow (advection), (2) contaminant mixing and spreading in ground water (dispersion), and (3) chemical reactions. Because ground-water flow is a major factor affecting the movement of contamination, transport models are used in conjunction with ground-water flow models. As a result, a transport model is only as reliable as the flow model with which it is coupled.

8.3 Overview of Ground-water Computer Codes

The major objective of this section is to present an overview of existing codes so as to provide a basis for evaluation of their capabilities and usability with regard to applications consistent with the objectives of the RI/FS. In recent years, several surveys have been conducted to assess available codes and their capabilities. Probably the most comprehensive report to date is by Bachmet et al. (1980) published by the American Geophysical Union. The study inventoried available codes and addressed their application to the decision processes in ground-water management. Although this reference is useful, it contains an inventory of hundreds of codes, which poses a difficult problem for code selection.

Three general criteria will guide code selection: (1) the physical and chemical processes of interest, (2) the study objectives, and (3) code availability. An understanding of the physical and chemical processes to be simulated is necessary in order to select a code that adequately represents the field problem. Also, if the study is preliminary in nature, or if only limited data are available, a simple code may be appropriate. Code selection also is strongly influenced by model availability. The most common of ground-water codes have been developed with public funding and as a result, are publicly available. These codes generally have a well-documented history of use and development.

8.3.1 Survey of Ground-water Computer Codes

Geraghty & Miller, Inc. conducted an evaluation on a diverse set of ground-water codes and utility software capable of solving a wide variety of ground-water problems from ground-water flow to partially saturated immiscible transport. They reviewed ground-water codes having analytical, semi-analytical, finite-difference,

and finite-element methods of solution in one, two, and three dimensions. Table 8-1 presents a list of the ground-water codes reviewed.

8.3.2 Model Summaries

(a) CHAINT. CHAINT is a two-dimensional numerical code for the analysis of contaminant transport in a fractured porous medium. The physical processes accounted for include advection, dispersion, diffusion, retardation, radionuclide chain decay coupling, and mass injection. The computational scheme employed by CHAINT is based on a Galerkin finite-element method and block-diagonal frontal solution technique. Principal input to this model consists of files from a predecessor, MAGNUM-2D simulation of buoyancy driven fluid flow.

(b) FEEST. FEEST is a two-dimensional finite-element flow code which employs the Marquardt Algorithm to perform automatic model calibration. The Marquardt Algorithm is a nonlinear least-squares technique which estimates aquifer properties including hydraulic conductivity, storage, and recharge in defined zones. Input to the model includes zonation of the aquifer based on geological information and water-level data from monitoring wells. FEEST runs the model iteratively until the sum of squared residuals (difference between observed and calculated water levels) is minimized. FEEST is an extension of the SEFTRAN flow and transport model (Section 8.1.3.2 (j), and input files are compatible between the two codes. Thus, the flow model can be calibrated by FEEST for subsequent transport analyses with SEFTRAN.

(c) FEMWATER/FEMWASTE. FEMWATER and FEMWASTE are Galerkin finite-element codes which simulate variably-saturated flow and transport, respectively. The original versions were two-dimensional; however, each has recently been expanded to three

Table 8-1. Model Summaries.

Model	Processes	Solution Method	Geometry
CHAINT	Flow/Transport	FE[1/]	2D
FEEST	Inverse Flow	FE/Marquardt[2/]	2D
FEMWATER/ FEMWASTE	Unsaturated Flow/ Transport	FE	3D
HST 3D	Flow/Transport	FD[3/]	3D
MAGNUM-2D	Flow	FE	2D
MODFLOW	Flow	FD	3D
MODEST	Inverse Flow	FD/Marquardt	3D
PORFLOW	Flow/Transport	FD	2D
RESSQ	Transport	Analytical	2D
SEFTRAN	Flow/Transport	FE	2D
SWANFLOW	Immiscible Flow	FD	3D
SWIFT II	Flow/Transport	FD	3D
STLINE	Particle Tracking	FD	3D

1/ FE = Finite Element
2/ Marquardt = nonlinear least-squares algorithm
3/ FD = Finite-Difference

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dimensions. Both codes were developed at Oak Ridge National Laboratory by G.T. Yeh.

Transport mechanisms include: convection, hydrodynamic dispersion, chemical sorption, and first-order decay. Implementation of quadrilateral isoparametric finite elements, bilinear spatial interpolation, asymmetric weighting functions, several time-stepping schemes, and Gaussian elimination are employed in the numerical formulation. The waste transport model (FEMWASTE) uses Darcy velocities calculated by the flow model (FEMWATER) to perform the transport calculations.

(d) HST3D. The Heat- and Solute-Transport Program (HST3D), developed by the U.S. Geological Survey, simulates groundwater flow and associated heat and solute transport in three dimensions. HST3D is based on the SWIPR code, which is also an ancestor of the current version of SWIFT II [Section 8.3.2 (1)]. The modeler may use the HST3D code for analysis of problems such as those related to subsurface water injection, landfill leaching, saltwater intrusion, freshwater recharge and recovery, radioactive-waste disposal, hot-water geothermal systems, and subsurface-energy storage. The three governing equations are coupled through the interstitial pore velocity, the dependence of the fluid density on pressure, temperature, and solute-mass fraction, and the dependence of the fluid viscosity on temperature and solute-mass fraction. The solute-transport equation is for only a single, solute species with possible linear equilibrium sorption and first-order decay. Finite-difference techniques are used to discretize the governing equations using a point-distributed (mesh-centered) grid. The flow-, heat-, and solute-transport equations are solved, in turn, after a partial Gauss-reduction scheme is used to modify them. The modified equations are more tightly coupled and have better stability for the numerical solutions.

The basic source-sink term represents wells. The Navy may use a complex well-flow model to simulate specified flow rate and pressure conditions at the land surface or within the aquifer, with or without pressure and flow-rate constraints. Boundary-condition types offered include specified value, specified flux, leakage, heat conduction, an approximate free surface, and two types of aquifer influence functions. All boundary conditions can be functions of time.

(e) MAGNUM-2D. MAGNUM-2D is a two-dimensional, finite-element computer code that simulates transient ground-water flow and heat transport in fractured, porous rock. A dual porosity approach is used in which flow through planar conduits is described by flow between parallel plates. The governing equations and finite-element solution techniques are given by Baca et al. (1981). The principal features of MAGNUM-2D are as follows:

- representation of the rock mass as a continuum by isoparametric finite elements,
- line elements to represent discrete fractures that are embedded along the sides of two-dimensional elements,
- stratigraphic features that include variable media properties,
- coupled or uncoupled solutions of heat and flow equations,
- flow-field calculations that provide input to flow path and radionuclide transport models (CHAINT),
- code documentation includes a user's manual and preliminary verification and benchmark testing.

(f) MODFLOW. The USGS Modular Three-Dimensional Finite-Difference Ground-Water Flow Model (MODFLOW) is based on a well-designed modular structure which allows for ease of modification. The modules are grouped into packages, each of which deals with a specific feature of the hydrologic system being simulated or with the type of solution technique. The division of the program into modules permits the user to examine specific hydrologic features on the model independently. This also facilitates development of additional capabilities because new modules or packages can be added to the program without modifying existing packages. The input and output systems are also designed to permit maximum flexibility.

Ground-water flow within the aquifer is simulated using a block-centered finite-difference approach. Layers can be simulated as confined, unconfined, or a combination of confined and unconfined. Flow from external stresses, such as flow to wells, areal recharge, evapotranspiration, flow to drains, and flow through riverbeds, can also be simulated. The finite-difference equations can be solved using either the Strongly Implicit Procedure (SIP) or Slice-Successive Overrelaxation (SSOR).

(g) MODEST. MODEST is a three-dimensional, finite-difference code that uses the Marquardt nonlinear least-squares algorithm to perform automatic steady-state and transient flow model calibrations. Geraghty & Miller, Inc. developed MODEST as a module for the publicly available and well-documented USGS modular flow code (MODFLOW). Hydraulic parameters estimated by MODEST include hydraulic conductivities, leakance coefficients, storage coefficients, and precipitation recharge. The code automatically adjusts specified model parameters to achieve a minimization of the sum of squared differences between field measurements of hydraulic head and model-calculated heads. The

automatic parameter estimation procedure in MODEST greatly reduces the time required for model calibration, thereby freeing more time for development/refinement of conceptual models and analysis of model results.

MODEST performs statistical analyses of the parameter estimation results that quantify model uncertainty. Standard errors and bivariate correlations are computed for the estimated hydraulic parameters in the model. The modeler can use the standard errors to construct approximate confidence intervals for the estimated parameters. Statistical treatment also includes analysis of the residuals (differences between field measurements of hydraulic head and model-calculated heads). The modeler provides residual maps and residual summary statistics.

Additional features in MODEST include a module that calculates Darcy flow velocities and a module for solving axisymmetric flow problems. The modeler can use the calculated Darcy velocities with particle-tracking programs such as STLINE.

(h) PORFLO. The PORFLO computer code, developed by Analytic and Computational Research, Inc., and BCS Richland, Inc., for the Basalt Waste Isolation Project, is a two-dimensional finite-difference code applicable to an equivalent porous medium. The code is capable of simulating the coupled processes of heat transfer in the water/rock system, ground-water flow in a layered geology, and transport of a dissolved radionuclide solute. The code can simulate two-dimensional areal or vertical geometries and axisymmetric problems. The modeler has developed a set of support codes and graphics software and interfaced with the PORFLO code that (1) compute and plot pathlines, streamlines, and travel times, (2) compute and plot the fractional release rates and cumulative

releases at specified boundaries, and (3) plot contours, spatial cross sections, and time histories for temperature, hydraulic head, and concentrations.

PORFLO uses a mesh-centered finite-difference grid to approximate the flow domain. The solution technique employed is the alternating direction implicit procedure (ADIP) composed with method of nodal point integration, also known as integrated finite differences.

(i) RESSQ. The RESSQ computer code calculates two-dimensional contaminant transport by advection and adsorption (no dispersion or diffusion) in a homogeneous, isotropic, confined aquifer of uniform thickness when regional flow, sources, and sinks create a steady state flow field. Recharge wells and ponds act as sources and pumping wells act as sinks. RESSQ calculates the streamline pattern in the aquifer, the location of contaminant fronts around sources at various times, and the variation of contaminant concentration with time at sinks. RESSQ was developed at Lawrence Berkeley Laboratory.

(j) SEFTRAN. The modeler may use the two-dimensional, finite-element model, SEFTRAN, to simulate ground-water flow and solute transport processes in fully saturated porous media. The model solves the flow and transport equations separately. Transport mechanisms considered include: advection, hydrodynamic dispersion, adsorption, and first-order decay.

The formation of the governing equations and the numerical approximation are based on a simplification of the Galerkin finite-element method. The simplification, called the influence coefficient technique, uses rectangular and triangular elements to reduce the computational requirements of numerical integration. This allows SEFTRAN to be more efficient than most finite-element

codes, while maintaining flexibility in defining complex flow regions.

Mass balance calculations permit the user to obtain the following information: (1) the net flow rate of fluid and contaminant entering the flow region, (2) the cumulative volumetric storage of fluid, (3) mass storage and decay of contaminant, and (4) mass balance error for each specified time step. The code has undergone extensive verification, validation, and benchmarking. SEFTRAN is used by governmental agencies and consultants around the world.

(k) SWANFLOW. SWANFLOW (Simultaneous Water Air and Nonaqueous Phase Flow) is a three-dimensional finite-difference code which simulates the flow of water and an immiscible nonaqueous phase within and below the vadose zone. The governing equations are a simplified subset of the three-phase flow equations commonly used in petroleum reservoir simulation. The modeler assumes pressure gradients in the gas phase (air) are assumed to be negligible. The SWANFLOW formulation is posed in terms of volumetric water saturation and fluid pressure in the immiscible fluid. The three-dimensional equations for flow are approximated by finite-differences in cartesian and cylindrical coordinates. The solution technique is slice successive over-relaxation (SSOR) imbedded in a Newton-Raphson iteration on nonlinear terms. Each vertical cross section (slice) of the grid is solved directly using a banded Gauss-Doolittle method with normal ordering. The system of slices is solved iteratively using SSOR. The resulting numerical model is very stable and potentially applicable to many problems associated with immiscible contaminants in ground water. SWANFLOW has been verified against analytical solutions and benchmarked with several other numerical models.

(l) SWIFT II. SWIFT II simulates ground-water flow and contaminant transport processes in porous and fractured geologic media. Originally, the code was developed for analyzing ground-water conditions at deep geologic nuclear waste disposal facilities, but it is equally applicable to the analysis of contaminant transport at hazardous waste sites.

SWIFT II is a fully transient, three-dimensional, finite-difference code that solves coupled equations for transport in geologic media including:

1) fluid flow
2) heat transport
3) density-dependent miscible displacement (brine)
4) miscible displacement of radionuclide or other dissolved contaminant species

The first three processes are coupled through fluid density and viscosity. Together, they provide the velocity field required for simulating the third and fourth processes (miscible displacement).

SWIFT II is an extension of the original SWIFT code developed by Sandia National Laboratories. It has a long QA history including extensive documentation, verification, validation, and benchmarking. Currently, Geraghty & Miller, Inc. and other consultants use the code to simulate ground-water flow and solute transport conditions at many different radioactive and hazardous waste disposal facilities in varied hydrogeologic settings.

(m) STLINE. STLINE is a publicly available particle-tracking program for analyzing ground-water streamlines and travel times in three-dimensional ground-water flow systems. The particle-tracking technique, which traces the movement of a molecule of water through a ground-water flow system, ignores

hydrodynamic dispersion, density-dependent flow, adsorption, and radioactive/biological decay. With these simplying assumptions, STLINE serves as a useful method of preliminary contaminant transport analysis. STLINE allows the analyst to (1) predict directions of contaminant migration, and (2) approximate "center-of-mass" travel times to receptor locations in the model. In addition, the particle-tracking results are valuable for designing more costly, numerical solute transport simulations.

STLINE uses a finite-difference, particle translation algorithm to track ground-water flow in a porous medium which has been discretized into a three-dimensional grid system of rectangular blocks. The code requires ground-water pore velocities at the grid-block interfaces are required by the code to translate the particles. STLINE allows the user a variety of options for controlling time-stepping in the calculations for an unlimited number of particles. The output from STLINE includes a complete history of simulated particle locations and times, and particle location maps at user-defined time intervals.

The USGS Modular Three-dimensional Finite-difference Ground-water Flow Model (MODFLOW) is based on a well-designed modular structure which allows for ease of modification. The Modules are grouped into packages, each of which deals with a specific feature of the hydrologic system being simulated or with the type of solution technique. The division of the program into modules permits the user to examine specific hydrologic features on the model independently. This also facilitates development of additional capabilities because new modules or packages can be added to the program without modifying existing packages. The input and output systems are also designed to permit maximum flexibility.

Ground-water flow within the aquifer is simulated using a block-centered finite-difference approach. Layers can be simulated as confined, unconfined, or a combinations of confined and unconfined. Flow from external stresses, such as flow to wells, areal recharge, evapotransporation, flow to drains, and flow through riverbeds, can also be simulated. The finite-difference equations can be solved using either the Strongly Implicit Procedure (SIP) or Slice-Successive Overrelaxation (SSOR).

8.4 Recommendations

The need for software compatibility in the performance of modeling task assignments is fundamental to achieving the goals and objectives of the RI/FS. The Navy should use publicly available, well-documented, and thoroughly tested models. This facilitates the transfer of technology between data bases and also the review of the work by external peer review teams.

For ground-water flow and solute-transport modeling, Geraghty & Miller has developed several software packages that facilitate the practical application of complex ground-water models. The software addresses many aspects of modeling, from preprocessing of model data sets to calibration of flow models to graphical analysis of model results. The specific modeling application programs recommended for use in the RI/FS process can be implemented through these packages. These software packages include the following:

ModelCad — A unique software package used to graphically design a ground-water flow or solute-transport model. ModelCad produces input data sets for several models including MODFLOW, and SWIFT II.

MODEST — A module for MODFLOW that automatically calibrates steady-state and transient ground-water flow models.

MODEST greatly simplifies the task of model calibration. MODEST also provides detailed sensitivity analyses and confidence intervals for model parameters.

GMGRAPH Creates a wide variety of graphics from model output files. The types of graphics include: (1) contour maps, (2) 3D mesh surfaces, (3) 3D mesh surfaces plotted over contour maps, (4) velocity vector maps, (5) plots of the model grid showing boundary conditions, and (6) standard XY plots. All plots may be annotated with a digitized base map.

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APPENDIX 4.1

BASIC SITE PLAN QA/QC PLAN
NAVAL AIR STATION - JACKSONVILLE
JACKSONVILLE, FLORIDA

CONTENTS

1.0 INTRODUCTION

The Basic Site Quality Assurance/Quality Control Plan (Basic QA/QC Plan) defines the necessary requirements and the procedures to be implemented for preparation and execution of the Basic Site Work Plan for Naval Air Station, Jacksonville (the Site). The Basic Site Work Plan describes the tasks that will be conducted at the Site and defines the scope and objectives of the Installation Restoration Program (IRP) activities as much as can be anticipated. The Basic QA/QC Plan is based on RCRA and CERCLA government guidance documents and the statement of work provided by Southern Division, Naval Facilities Engineering Command.

2.0 DESIGNATED TASKS

2.1 Planning

2.1.1 Scoping Process

Scoping is the initial planning stage of the Remedial Investigation. The planning includes two phases:

1) Background and Problem Summary; and
2) History of Response Actions.

The Background and Problem Summary consists of collecting and analyzing existing data to summarize the nature and extent of the problem. These data may include hydrogeologic, meteorologic and chemical information, and maps. The existing reports will be reviewed in order to accomplish this task.

Several tasks will be conducted to develop the Background and Problem Summaries:

1) Review existing data from project files;

2) Define and describe the area of the Site, operable unit (OU), or potential source of contamination (PSC);

3) Provide a summary pertaining to the regional location of the Site, OU, or PSC, pertinent boundary features, physiography, hydrology and geology;

4) Determine the nature of the problems that have affected the Site, OU, or PSC;

5) Review the use of the Site, OU, or PSC relative to solid waste disposal;

6) Summarize existing data to formulate the Site, OU, or PSC background;

7) Provide meteorological data and a wind rose;

8) Summarize on-site and off-site hazards to public health, and to the environment; and

9) List the types of hazardous substances, storage-disposal practices, affected media, pathways of exposure, contaminated leachate and runoff, and human population and environment exposure.

The History of Response Actions describes previous actions at the Site, including government environmental programs implemented

to review the Site, regulatory responses, and a summary of applicable reports. The existing files, including the correspondence file, will be reviewed to accomplish this task.

Several tasks will be conducted to develop the History of Response Actions:

1) Review existing data and selected reports from the project files;

2) Summarize findings, and conclusions and recommendations of selected reports; and

3) List major environmental actions, regulatory, and remedial actions to data responses.

2.1.2 Site Visits

The Site will be visited to verify the information gathered during the Background and Problem Summary and to screen selected OUs/PSCs for existing conditions. In addition, boundary conditions will be established to ensure subsequent investigations include the appropriate areas. The boundary conditions will also be utilized to establish site access and site security.

2.1.3 Site Maps

A map of the Site and each OU/PSC will be developed which will include the locations of each OU/PSC and topographic features. Several tasks are conducted to develop the maps:

1) Obtain 7-1/2 minute quadrangle topographic maps from the U.S. Geological Survey (USGS);

2) Review IAS Site maps;

3) Prepare Site location map using USGS map;

4) Develop digitized maps for each OU/PSC using computer-aided drawing and drafting (CADD) and add data to maps from the IAS report and information gathered during the OU/PSC visit; and

5) Edit existing maps as necessary for inclusion in reports.

2.2 Development of Alternatives

2.2.1 ARARs

Applicable or relevant and appropriate requirements (ARARs) will be established and utilized to define acceptable exposure concentrations of chemicals of concern at the Site. The ARARs, to some extent, will impact on the selection of appropriate remedial actions. Several tasks are conducted to develop ARARs:

1) Compile and evaluate existing data within the project files;

2) Review existing state and federal ARARs;

3) Review available advisories and guidance documents for non-ARAR toxicology-based levels;

4) Review existing local ordinances; and

5) List ARARs as they are identified.

2.2.2 Remedial Action Objectives

The Basic Site Work Plan will contain the objectives of remediation. For various matrices, the remedial action objectives may include:

1) prevent direct contact, inhalation, and ingestion;

2) prevent additional releases and migration of contaminants; or

3) restoration of the environment.

The tasks to be conducted to develop Remedial Action Objectives are:

1) Identify past and current sources of contamination;

2) Identify potential release mechanisms;

3) Identify potential exposure points;

4) Identify potential exposure routes and receptor populations;

5) Determine exposure point concentrations from monitoring data or modeling;

6) Calculate exposure dosage rates;

7) Assess non-cancer public health concerns based on the ratio of acceptable daily dosages to exposure dosages;

8) Assess lifetime excess cancer risks based on product of exposure dosage and cancer potency factor;

9) Identify potential public safety and welfare concerns;

10) Compare exposure point concentrations to criteria for protection of aquatic life;

11) Identify potential food-chain concerns and estimate concentrations at various tropic levels; and

12) Identify potential impacts to threatened or endangered species sighted in the area.

2.2.3 Remedial Action Technologies

Remedial actions are remedies designed and implemented to prevent or minimize the present or future danger to human health and the environment from constituents of concern. Methods to identify remedial technologies that will meet these objectives are listed within the Basic Site Work Plan. Possible technologies may include extraction, collection, containment, continued monitoring, or no action. The listing of technologies will be diverse in order to accommodate the range of potential remedial objectives, medias of concern, and ARARs.

The tasks to be conducted to develop remedial action technologies are:

1) Identify areas where containment alternatives may be appropriate and feasible to implement;

2) Define containment objectives which will eliminate risks associated with site;

3) Define containment objectives for compliance with ARARs;

4) Define containment alternatives based on site and waste characteristics;

5) Confirm that alternatives meet objectives;

6) Review existing literature for technologies that reduce toxicity, mobility, and/or volume or contain constituents;

7) Develop an understanding of the effectiveness, applications, and costs of the technologies; and

8) Develop a listing of technologies.

2.3 Quality Assurance and Quality Control

2.3.1 Data Gathering Plan

The Data Gathering Plan (DGP) will consist of protocols for sampling preparation and a Basic Sampling and Analysis Plan (BSAP). The major components of the BSAP include a Basic Field Sampling Plan (BFSP) and a Quality Assurance Program Plan (QAPP).

The tasks for the preparation of these plans include:

1) Review of federal and state guidance documents;

2) Review existing files for information on constituents and matrices of concern;

3) Identify matrices to be investigated;

4) Review regulatory Maximum Concentration Limits; and

5) Review previous site activities;

The tasks conducted to prepare the BFSP are:

1) Select applicable field sampling protocols;

2) Determine required equipment;

3) Identify the need for field chemical analysis; and

4) Define level of field analysis reportable quality control.

Specific tasks conducted to prepare the QAPP are:

1) Establish required detection limits;

2) Select subcontractor laboratories;

3) Obtain laboratory Quality Assurance Plans;

4) Confirm laboratory limits of detection; accuracy, precision, and completeness;

5) Select appropriate level of reporting and laboratory deliverables; and

6) Select appropriate level of field quality control sample collection.

2.3.2 Data Analysis Plan

Data validation procedures will be addressed in the Data Analysis Plan. The validation procedure may include contract compliance screening, determinations of data usability, and compliance with data quality objectives. A check-off sheet will be developed and included for use when reviewing analytical data. The tasks to be conducted to prepare the Data Analysis Plan include:

1) Obtain most recent Environmental Protection Agency (EPA) CLP statement of work;

2) Obtain most recent EPA data validation guidelines;

3) Review and tabulate SW-846 QA/QC criteria;

4) Review contract laboratory report format for completeness;

5) Review field sample collection forms and documentation;

6) Prepare field QC report forms;

7) Review analysis request forms and chain-of-custody forms for completeness; and

8) Prepare a data validation checklist,

2.3.3 Final Product Report Plan

Review procedures will be developed for validation of the decision process, compliance of identified project objectives, data quality objectives, and ARARs. The tasks to be conducted to prepare the Final Report Plan include:

1) Review applicable guidance documents;

2) Review objectives of the Basic Site Work Plan;

3) Develop a table of contents for the Work Plan; and

4) Develop checklist to ensure objectives are addressed when preparing the Basic Site Work Plan.

2.3.4 Data Management Plan

An extensive data base presently exists for work conducted at the Site and additional data will be generated throughout the IRP process. A procedure to track and document data and results will be established. Selected data may be categorized as follows: field activities, sample management and tracking, and document control and inventory. In addition, a file structure will be established. The tasks to be conducted to prepare the Data Management Plan include:

1) Identify file repository;

2) Establish a recordkeeping format;

3) Prepare a draft document control form;

4) Identify document control personnel;

5) Determine access priority of project personnel to the project files;

6) Determine the interface requirements of the CADD system;

7) Determine the data formats available from the laboratories;

8) Determine the data format compatible with proposed models;

9) Determine a computer software package to be used in maintaining the data base; and

10) Establish archive procedures for computerized data bases.

2.4 Health and Safety

2.4.1 Corporate Health and Safety Plan

Health and safety protocols and procedures will be implemented and documented for all phases of field work conducted at the Site. Guidelines will be established for personnel training, supervision, and protective equipment. The tasks to be conducted to prepare the Health and Safety Plan include:

1) Develop a list of Site contacts (names and telephone numbers) and an organization chart for the project;

2) Obtain and review copies of Health and Safety Guidance Documents and OSHA Regulations;

3) Gather information about OU-specific safety and health requirements and emergency procedures from Site personnel;

4) Develop a list of the OUs/PSCs to be investigated, their locations, and analytical data obtained from soil, air, ground water, and surface water samples;

5) Review task descriptions that will be conducted at each OU/PSC during the investigation; and

6) Identify the locations of limited access areas at the Site.

2.4.2 OU-Specific Health and Safety Plan

Reference will be made to the Site Health and Safety Plan for field procedures implemented at the OU or PSC. This plan will include specific recommendations for the proper levels of Health and Safety and control boundaries.

2.5 Modeling Applications

Models will be reviewed to determine their applicability to the IRP work at the Site. Criteria will be established for the acceptance or rejection of a model's particular application to OU-specific work. The tasks to be conducted to review Modeling Applications include:

1) Survey existing ground-water flow models;

2) Survey existing solute-transport models;

3) Identify models applicable to Site conditions;

4) List and discuss model types and characteristics;

5) Assess applicable models with regard to applications, input requirements, availability, documentation, and usability; and

6) Recommend models for use in the IRP.

2.6 OU-Specific Plans

2.6.1 Sampling and Analysis Plan

This plan will be based on the BSAP. The plan will define sampling objectives, equipment specifications, recommendations for sampling frequency, sample types, locations, and parameters. The tasks to be conducted for preparation of the OU-Specific Sampling and Analysis Plan include:

1) Review previous OU/PSC activities;

2) Identify parameters of interest;

3) Review previous work performed;

4) Create target compound list;

5) Determine number of samples to be collected from each matrix;

6) Identify the field analyses to be performed;

7) Select subcontractor lab;

8) Identify any items that cannot be incorporated by reference; and

9) Meet with project coordinator to confirm OU-specific information.

2.6.2 Waste Characterization Plan

This plan defines procedures to characterize chemicals and materials at the OUs/PSCs. The tasks to be conducted to prepare the Waste Characterization Plan include:

1) Compile information on waste materials through an examination of records existing at the Site;

2) Conduct OU/PSC inspection;

3) Describe methodologies to identify buried wastes, review areal photographs, and conduct a literature review; and

4) Review available literature and/or commercial computerized data bases to compile physical and chemical characteristics of materials of interest.

2.6.3 Hydrogeologic Investigation

Various methods will be utilized to define the horizontal and vertical extent of contamination in the ground water at each OU/PSC. Included will be descriptions of selected investigative techniques such as soil gas monitoring, monitor well installation,

and ground-water probes. The tasks to be conducted to prepare the Hydrogeologic Investigation include:

1) Compile and evaluate existing data within the project file pertaining to hydrogeology and test methods previously utilized during OU/PSC investigations;

2) Identify and contact potential sources of hydrogeologic data such as Water Management Districts and U.S. Geological Survey offices within Florida;

3) Review available guidance documents;

4) Review available technical documents describing testing and reconnaissance methods;

5) Conduct meetings with selected staff of Geraghty & Miller to review new test methods; and

6) Develop a listing of hydrogeologic investigation methods.

2.6.4 Soils and Sediment Investigation

A review of existing soil data will be utilized as the bases for establishing a plan for soil sampling and determining the extent of soil contamination. The tasks to be conducted to prepare the Soils and Sediment Investigation Plan include:

1) Review previous OU/PSC activities;

2) Identify parameters of interest;

3) Review previous work performed;

4) Create target compound list;

5) Determine number of samples to be collected from each matrix;

6) Identify the field analyses to be performed; and

7) Select subcontract lab.

2.6.5 Surface-Water Investigation

Procedures will be described for locating and identifying surface water, and determining impacts on surface water from contaminants. The tasks to be conducted to prepare the Surface Water Investigation Plan include:

1) Review previous OU/PSC activities;

2) Identify parameters of interest;

3) Review previous work performed;

4) Create target compound list;

5) Determine number of samples to be collected from each matrix;

6) Identify the field analyses to be performed; and

7) Select subcontract lab.

2.6.6 Air Investigation

The tendency for selected constituents to enter the air will be considered when establishing methods to determine the presence or absence of airborne contamination. The tasks to be conducted to prepare the Air Investigation Plan include:

1) Develop a list of the chemicals previously reported during sampling programs (ground water, surface water, soil, sediment, air) at the Site;

2) Review historical descriptions of each OU/PSC and determine whether previous sampling programs were adequate to characterize the OU/PSC;

3) Evaluate the health risks posed by chemicals previously detected or suspected at each OU/PSC and select a group of target analytes from the available information;

4) Obtain a copy of NIOSH air sampling procedures or equivalent references to determine which analytical sampling programs are appropriate;

5) Review the operation of the air sampling equipment and determine which of the target analytes can be analyzed with existing equipment;

6) Determine the need to either subcontract the more difficult target analytes or to purchase the necessary equipment.

2.6.7 Biological Investigation

Selected constituents, when present, may impact Site biota. Procedures will be described to establish the potential or actual impacts to the ecological system. The tasks to be conducted to prepare the Biological Investigation Plan include:

1) Review previous reports prepared for the military that describe environmental issues, biological community descriptions, and species lists;

2) Order and review previous reports that were prepared for municipal, state, or federal projects conducted in adjacent communities;

3) Order and review aerial photographs that show the size, shape, and general composition of the plant communities at the Site. These photographs may be used also to delineate wetlands, wooded and grassy areas, and occupied zones;

4) Obtain EPA and state guidance criteria documents that outline methods to conduct a biological survey and sampling plan; and

5) Conduct an OU/PSC visit to evaluate the diversity of the biological community and its applicability to previous reports.

2.6.8 Radiological Investigation

When the potential for radiological constituents exists at selected OUs/PSCs, the procedures established in this plan will be

utilized to determine the presence or absence of these constituents and their potential impacts. The tasks to be conducted to prepare the Radiological Investigation include:

1) Review existing literature with regard to the past use, transport, storage, and disposal of radiologic substances and materials at the Site;

2) Review current regulations regarding radiologic exposure limitations and maximum allowable radionuclide concentrations in air, soils, and ground water;

3) Inventory any radiologic substances or radionuclides identified through the waste characterization plan;

4) Review information on sampling and detection methods for suspected radionuclides; and

5) Determine the availability and condition of appropriate sampling and detection equipment.

3.0 SUMMARY OF APPLICABLE PROJECT REPORTS

1. Correction Action Plan, Industrial Sludge Drying Beds, Industrial Wastewater Treatment Plant, NAS, Jacksonville, Florida
   August 1989
   (Geraghty & Miller, Inc.)

2. Compliance Monitoring Sampling Report (Third Quarter) Industrial Wastewater Treatment Plant
   NAS, Jacksonville, Florida
   May 1989
   (Geraghty & Miller, Inc.)

3. Fourth Quarter Compliance Monitoring Sampling Report for April, May, and June, 1989, at the Industrial Wastewater Treatment Plant, NAS, Jacksonville, Florida
June 1989
(Geraghty & Miller, Inc.)

4. Contamination Assessment of Building 795, The Addition-Naval Air Station-Jacksonville, Florida
February 1989
(Geraghty & Miller, Inc.)

5. Appendix IX Compliance Sampling Report
Industrial Wastewater Treatment Plant, NAS, Jacksonville
February 1989
(Geraghty & Miller, Inc.)

6. Corrective Action Program, Sludge Drying Beds, Industrial Wastewater Treatment Plant, NAS, Jacksonville, Florida
October 1988
(Geraghty & Miller, Inc.)

7. Findings from the Subsurface Investigation at the Wright Street Naval Air Station-Jacksonville, Florida
September 1988
(Geraghty & Miller, Inc.)

8. Plume Delineation Report (Draft-never submitted), Industrial Wastewater Treatment Plant, NAS, Jacksonville, Florida
September 1988
(Geraghty & Miller, Inc.)

9. Results of Electromagnetic Terrain Conductivity Survey, Industrial Wastewater Treatment Plant, NAS, Jacksonville
July 1988
(Geraghty & Miller, Inc.)

10. Conceptual Design Report, Industrial Wastewater Treatment Plant, Sludge Drying Beds, Groundwater Treatment, Industrial Wastewater Treatment Plant, NAS, Jacksonville, Florida
June 1988
(G&M Consulting Engineers)

11. Compliance Sampling Report, Industrial Wastewater Treatment Plant, NAS, Jacksonville, Florida
April 1988
(Geraghty & Miller, Inc.)

12. Results of Hydrogeologic Evaluation and Appendix IX, Sampling Industrial Wastewater Treatment Plant, NAS, Jacksonville, Florida
December 1987
(Geraghty & Miller, Inc.)

13. As-Built Report, Installation of Monitor Well NAS 4-11 at Industrial Wastewater Treatment Plant Sludge Drying Beds, NAS, Jacksonville, Florida
October 1987
(Geraghty & Miller, Inc.)

14. Results of Monitor-Well Sampling of Well NFD-5 at Naval Fuel Depot (NFD), Jacksonville, Florida
August 1987
(Geraghty & Miller, Inc.)

15. As-Built Report for Two Monitoring Wells, Solvent and Oil Disposal Site, NAS, Jacksonville, Florida
June 1986
(Geraghty & Miller, Inc.)

16. Predesign Report
Oil and Solvent Dump Site
Remedial Action Plan
May 1986
(Jones, Edmunds, & Associates, Inc.)

17. Naval Assessment and Control of Installation Pollutants Review Workshop, NAS, Jacksonville, Florida
April 1986
(Geraghty & Miller, Inc.)

18. Characterization Phase
Assessment of Ground-Water Contamination at Naval Air Station-Jacksonville, Florida
March 1986
(Geraghty & Miller, Inc.)

19. Verification Study
Assessment of Potential Ground-Water Pollution at Naval Air Station-Jacksonville, Florida
December 1985
(Geraghty & Miller, Inc.)

20. Results of Sediment Sampling at the Plating and Cleaning Shop, Building 101, NAS, Jacksonville, Florida
November 1985
(Geraghty & Miller, Inc.)

21. NACIP Program
Confirmation Study-Verification Phase
March 1985
(Geraghty & Miller, Inc.)

22. Draft Report
Closure Plan for the Spent Glass Bead Waste Pile, NAS, Jacksonville, Florida
February 1985
(Geraghty & Miller, Inc.)

23. Closure Certification of the Spent Glass Bead Waste Pile, NAS, Jacksonville, Florida
January 1985
(Geraghty & Miller, Inc.)

24. As-Built Ground-Water Monitoring Network at the WWTP Polishing Pond, NAS, Jacksonville, Florida
June 1984
(Geraghty & Miller, Inc.)

25. Assessment of the Presence of Fuel in the Subsurface at Gas Hill, Naval Air Station, Jacksonville, Florida
December 1983
(Geraghty & Miller, Inc.)

26. Final Report
Ground-Water Monitoring Plan for RCRA Compliance, Naval Air Station-Jacksonville, Florida
October 1983
(Geraghty & Miller, Inc.)

27. IAS

28. 100% Submittal Pits

4.0 BASIC SITE QA/QC PLAN CHECK-OFF SHEET

Scoping: Was scoping conducted to include the Background Summary, Problem Summary, and Historical Response?

Yes ____ No ____

Comments: _____

_____

_____.

Site Maps: Have maps been prepared for each OU/PSC?

Yes ___ No ___

Comments: _____

Development of Alternative: Have methods been developed to identify ARARs, Remedial Action Objectives, and Remedial Action Technologies? Yes ____ No ____

Comments: _____

Quality Assurance/Quality Control: Have the following plans been Data Gathering, Data Analysis, Final Product Report, and Data Management?

Yes ____ No ____

Comments: _____

Health & Safety: Have Health & Safety Plans been developed for the Site and each OU/PSC? Yes ____ No ____

Comments: _____

Modeling Applications: Have models been reviewed to determine their applicability to IRP work at the Site?

Yes ____ No ____

Comments: _____

OU-Specific Plans:

Sampling and Analysis:	Have Sampling and Analysis Plans been developed for the Site and each OU? Yes ____ No ____
Waste Characterizations:	Have Waste Characterization Plans been developed for the Site and for each OU? Yes ____ No ____
Hydrogeologic Investigation:	Have Hydrogeologic Investigation Plans been developed for the Site and each OU? Yes ____ No ____
Soil and Sediment Investigation:	Have Soil and Sediment Investigation Plans been developed for the Site and each OU? Yes ____ No ____
Surface-water Investigation:	Have Surface-water Investigation Plans been developed for the Site and each OU? Yes ____ No ____
Air Investigation:	Have Air Investigation Plans been developed for the Site and each OU? Yes ____ No ____
Biological Investigation:	Have Biological Investigation Plans been developed for the Site and each OU? Yes ____ No ____
Radiological Investigation:	Have Radiological Investigation Plans been developed for the Site and each OU? Yes ____ No ____
Site Management Plan:	Has a strategy been established for determining operable units and has the strategy been documented in the Site Management Plan? Yes ____ No ____

Comments: _____
_____
_____.

Risk Assessment:

Have Risk Assessments been developed for the Site and each OU?
Yes ____ No ____

Comments: _____
_____
_____.

Treatability Studies:

Have Treatability Studies been developed for the Site and each OU?
Yes ____ No ____

Comments: _____
_____
_____.

Feasibility Study:

Have Feasibility Studies been developed for the Site and each OU?
Yes ____ No ____

Comments: _____
_____
_____.

_____
Signature

APPENDIX 4.2

DATA ANALYSIS PLAN
NAVAL AIR STATION - JACKSONVILLE
JACKSONVILLE, FLORIDA

CONTENTS

CONTENTS

CONTENTS (Continued)

FIGURES

CONTENTS (Continued)

ATTACHMENTS

1.0 DATA VALIDATION PROCESS AND ORGANIZATION

Data validation is a two-fold process: (1) field data are evaluated for adherence to the approved work plans and field documentation are reviewed; (2) analytical (laboratory) data are evaluated for completeness of data package deliverables (Contract Compliance Screening) and achievement of project specific data quality objectives (data usability determination). Based on the results of this evaluation, a determination can be made as to: (1) the need for re-sampling and analysis; (2) the data usability for decisions (unusable, qualitative, or quantitative); (3) the appropriateness of penalties, and reductions in test charges on laboratory invoices; (4) the appropriateness of billing the laboratory the direct costs associated with correcting data packages; and, (5) the allocation of responsibility for paying re-sampling costs.

During the process of validation, all aspects of the sampling and analysis program are reviewed. This document provides guidance for persons conducting data validation. The procedures are based on functional guidelines developed by the U.S. Environmental Protection Agency (EPA), the guidelines established in the document entitled "Sampling and Chemical Analysis Quality Assurance Requirements for the Navy Installation Restoration Program", NEESA 20.2-047B, and the accumulated experience of numerous technical persons qualified in data validation procedures. The manual describes those procedures and/or review processes that have been found to be successful in revealing program failures or defects in the quality and/or defensibility of the analytical data. The contents of this manual are organized into sections and include: (1) descriptions of the required "tools" for conducting data validation; (2) step by step procedures for conducting the data review and completing appropriate checklists; (3) preparation of

quality control summary report; and, (4) procedures for resolving problems with data and applying penalties to the laboratory.

A fundamental aspect of any data validation program is the established relationship with the laboratory. The use of laboratories will be accomplished by a laboratory services agreement (contract) between the Contractor and the laboratory. The contract must specify the scope of services to be performed by the laboratory, the specific analytical quality assurance requirements to be met, and the information to be developed and reported. Quality assurance levels (Level D and Level C) adopted by the Navy and described in the Quality Assurance Program Plan (QAPP) and the NEESA 20.2-047B document will be adhered to.

1.1 Data Package Deliverables

As analyses are completed, the digital, electronic, or physical data will be reduced and converted into readily usable form by the laboratory in measurement units appropriate for the analysis. All measurements will be reported in appropriate significant figures. Table 7 of the QAPP presents the significant figures to be used in reporting analytical data. The following discussion describes the information to be provided by the contracted laboratories in each data package submittal.

1.1.1 Level D

For Level D, Quality Control (QC), a CLP data package shall be delivered for all the CLP parameters (volatiles, semi-volatiles, pesticides/PCBs, metals, and cyanide). This package shall include the summary package and the remainder of the package, which includes but is not limited to initial and continuing calibration, matrix spikes, matrix spike duplicates, method blanks (water

blanks, extraction blanks, digestion blanks), duplicates, laboratory control samples, surrogate spike recoveries, chromatograms, mass spectra, and absorbance data. The full description of the required deliverables is contained in the EPA, CLP Statement of Work (most current version) referenced in Attachment A.

Methods not defined by CLP also must be reported. These methods include the calibration information, method blanks, reagent water (blank) spikes, laboratory control samples matrix spikes, matrix spike duplicates, chromatograms, and absorbances. Control chart plots of associated blank spike recovery data must also be presented with the data.

1.1.2 Level C

For Level C QC, reportable data includes the method blanks, blank spikes, surrogates, matrix spikes, matrix spike duplicates, laboratory (sample) duplicates, and initial and continuing calibration data. These deliverables and their required forms are summarized and explained in detail in Table 8 of the QAPP. A copy of these requirements is presented in Attachment A of the this plan. The forms referred to in this table are from the current CLP statement of work for organics, metals, and cyanide.

1.2 Data Validation

Following completion of sample analysis, the contract laboratories will utilize precision and accuracy criteria presented in their respective generic QAPs as guidance for internal laboratory data validation prior to submittal of data packages.

The data validation procedures employed by the Contractor will include an evaluation of the field data package and an evaluation of the laboratory analytical data package. The criteria for data validation will be in accordance with the requirements established by the Navy in the NEESA 20.2-047B, document. This document specifies the validation requirements for both Level D and Level C data packages. These requirements are listed below.

1.2.1 Level D Validation

The data validation procedures that will be used to evaluate data for Level D data will be in accordance with the CLP criteria as outlined in the following documents:

- EPA, Hazardous Site Evaluation Division, Laboratory Data Validation Functional Guidelines for Evaluating Pesticides/PCB's Analyses, February 1, 1988 (most current revision);

- EPA, Hazardous Site Evaluation Division, Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses, February 1, 1988 (most current revision);

- EPA, Hazardous Site Evaluation Division, Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses, July 1, 1988 (most current revision);

These documents are presented in Attachments B and C, respectively. The pesticide criteria is a separate section of the organics criteria (Attachment B).

1.2.2 Level C Validation

The validation criteria to be followed for Level C data packages also has been defined in the NEESA 20.2-047B document and is presented in Attachment D. In addition, the criteria defined in the EPA documents presented in Attachments B and C also will be used in validation of Level C data.

1.2.3 Laboratory Services Agreement (Contract)

The validation procedures described in this manual have been tailored to interface with the ABB Environmental Data Station (EDS). The EDS requirements and the compliance screening validation process are compatible with Navy requirements. The laboratory services agreement, between the Contractor and the Laboratory, plays a significant role in establishing laboratory accountability for analytical performance and an efficient system of communicating required scopes of work to the laboratory.

The data validation process for both Level D and Level C data packages will be guided by the use of Data Validation Report Sheets (DVRS) forms, presented in Attachment E. These forms have been adopted from the EPA CLP Sample Management Office. These DVRS forms are the QC specific forms used to evaluate each QC parameter submitted in the laboratory data package. A separate form has been designed for each QC parameter. Separate form sets have been prepared for organics analyses, (volatiles, semi-volatiles, pesticides and PCBs) and inorganics analyses (metals and cyanide). A special checklist form has been prepared for Wet Chemistry QC to complete the DVRS forms. These forms contain the following kinds of information:

- QC parameter type

- Project description
- Site name and location
- Sample batch or group identification
- Sample collection date
- Sample matrix type
- Parameters of interest
- QC criteria for evaluation of the QC parameter as acceptable, provisional, unacceptable or not applicable
- Remarks area for noting identification of specifically affected samples or observations noted about the data and defining the appropriate qualifier code to be applied.

These DVSR forms are further supplemented by a Field Data Validation Checklist (FDVC) form and a Master Sample List (MSL) form that are used to evaluate field data packages (defined in Chapter Two). The FDVC and MSL forms are presented in Attachment F.

1.3 Data Validation Process

During the validation process both the field data, documentation, and procedures and the analytical data and documentation are evaluated. The sequence of review begins with an evaluation of the field documentation. During the field data package validation all of the pertinent field records should be reviewed for conformance to specifications designated by the QAPP.

Also, during the review process, the field data validation checklist should be completed. Upon completion, the checklist should be signed and dated by the data reviewer and the QAO.

Following the review of the field data, the analytical data package deliverables should be validated. In this instance it is important for the data reviewer to understand the nature of the deliverables provided by the laboratory in the data package. Often the organization of these documents must be rearranged in a logical fashion that will enable the reviewer to evaluate the data systematically. Typically, this reorganization procedure must be accomplished before the data validation process can begin. In addition, before beginning the data validation process, the data reviewer must obtain all the required documents ("tools") that will be used in conducting the validation. The actual process of the analytical data validation review involves three basic steps: (1) Contract Compliance Screening (CCS); (2) data usability determination; and (3) report preparation. In these steps the reviewer of the data verifies that the laboratory has complied with the requests submitted on a laboratory task order and submitted a deliverables package that is complete, competent, and responsible.

As used here the term complete means that the reviewer ensures that all the deliverables contracted for have been provided within the required turnaround time. The term competent as used here means that the deliverables are free from substantive defects of workmanship such as severe typographical errors, misstatements of methods, detection limits, parameters, dates, or other information, poor copying, poor organization, etc. This evaluation has nothing to do with determining if the DQOs have been achieved; that occurs during the data usability determination (step 2).

The term responsible as used here means the reviewer also evaluates the data package narrative summary to determine if the laboratory has attempted to interpret the data in terms of some law, regulatory standard or code, or health risk advisory. Doing so is considered to be irresponsible action on the part of the laboratory.

If any of the above circumstances should occur the data package may be considered irresponsible and classified as unacceptable until the discrepancy has been corrected by the laboratory. Under the terms of the laboratory services agreement, failures in any of these areas by the laboratory may be subject to financial penalties. During the contract compliance screen process, the contract compliance screen checklist is completed and signed by the data reviewer and quality assurance officer.

After contract compliance screening has been completed the data is checked against the validation criteria established for the level of QC requested. During this process the DVRS forms are completed along with the MSL form. Regulatory holding times are evaluated and the QC data is compared to the specified DQOs. In addition, the analytical results are tabulated for each matrix for all samples.

As each QC parameter is evaluated, the DVRS form for that parameter is completed and the applicable raw and reduced data submitted by the laboratory is attached. In addition, the validation criteria rules are applied and the data is classified for use, by assigning appropriate qualifier codes to the sample results. These codes and more details about the validation process are described in subsequent sections of this manual. The codes provide a means of signifying how the data may be used.

Ultimately, based on these codes, the data is classified as either unusable, qualitative, or quantitative.

After completing the review of all of the QC data, the completed DVRS forms and their attached raw and reduced support data are compiled into a master Quality Control Summary Report (QCSR). The QCSR presents all of the required field data validation results and the analytical data validation results along with the tabulated data specified by the NEESA 20.2-047B document.

2.0 MATERIALS FOR VALIDATION

In order to conduct data validation properly, certain documents and forms are required. A list of these various documents along with a brief explanation of each is provided below.

2.1 BSAP/SAP

The BSAP, composed of the Quality Assurance Program Plan (QAPP) and the Basic Field Sampling Plan (BFSP), provides the foundation for the OU-specific plans and hence the foundation for the validation process. OU-Specific Sampling and Analysis Plans (SAPs) are composed of a Quality Assurance Project Plan (QAPjP) and an OU Field Sampling Plan (OU FSP). The QAPjP and the OU FSP are the fundamental documents for enabling data validation of data from a specific OU. The OU FSP defines the OU-specific field sampling activities and procedures and the QAPjP defines the required OU-specific data quality objectives (DQOs) and the appropriate sampling and analysis procedures to be employed. All of these documents provide a standard against which data quality may be compared and assessed.

2.2 Laboratory Task Order

The Laboratory Task Order (LTO) (Figure 1) is used to communicate to the laboratory the required scope of work and the DQOs for specific projects. The DQOs specified on the LTO include: matrix type, parameters (analytes) of interest, methods of analysis, detection limits, and holding times. Within these DQOs are defined the required container types, preservation methods, and sample volumes. These requirements also are defined in the QAPP and QAPjP. Other DQOs for precision, accuracy, and completeness are specified by the laboratory within their generic QAPs presented

FIGURE 1

LABORATORY TASK ORDER

Task Order No.: 2816

Office: _____ Phone: _____ Date: _____

Address: _____ Project Number: _____

_____ Laboratory Reporting Level: ☐ I ☐ II ☐ III ☐ IV

Project Name: _____ Location: _____

Laboratory: _____ Phone: _____ Contact: _____

Lab Provides Sample Containers? ☐ Yes ☐ No Date Required: _____ Ship To: _____

Estimated Date Of Sample Receipt By Laboratory: _____ Report Due: _____

Reports Delivered To: _____ Number Of Reports: _____

Work Description: _____

Send Invoice To: _____

PHYSICAL PROPERTIES	# Water	Method	Det. Limit	# Soil	Method	Det. Limit	NON-METALLICS	# Water	Method	Det. Limit	# Soil	Method	Det. Limit
pH							Acidity						
Spec. Cond.							Alkalinity (Total)						
Hardness (total)							Carbonate						
TDS							Bicarbonate						
TSS							Bromide						
Temperature							Chloride						
Turbidity							Cyanide						
Ignitability							Fluoride						
Corrosivity							Ammonia						
Reactivity							Nitrate						
E.P. Tox. Extraction							TKN						
TCLP Extraction							Nitrite						
E.P. Tox. Complete							Phosphorus						
TCLP Complete							Silica						
METALS*							Sulfate						
Aluminum							Sulfide						
Antimony							Surfactants (MBAS)						
Arsenic							ORGANICS						
Barium							BOD						
Beryllium							COD						
Cadmium							Oil & Grease						
Calcium							TOC						
Chromium							TOX						
Hex Chromium							TRPH						
Copper							Purg. Halocarbons*						
Iron							Non-Halogenated VOCs*						
Lead							Purgeable Arom.*						
Magnesium							Phenols*						
Manganese							Pesticides/PCBs*						
Mercury							PNAs*						
Nickel							Org. Phos. Pest.*						
Potassium							Dioxins						
Selenium							Other Hers.*						
Silver							Volatile Organics*						
Sodium							Semi Volatile Organics*						
Thallium							APPENDIX IX*						
Tin							RADIONUCLIDES						
Vanadium							Gross Alpha -						
Zinc							Gross Beta						
Priority Pollutant Metals*							Radium 226						
TCL (NSL) Metals*							Radium 228						

* Metals are Total Metals Unless Specified as Dissolved Under Special Instructions. * Attach Table of Elements or Compounds to be Analyzed. * Includes All Organic and Inorganic Compounds.

Special Instructions Or Other: _____

Project Manager Signature: _____ Date: _____ QA Officer Signature: _____ Date: _____

Laboratory Acceptance: _____ Date: _____

LABORATORY TASK ORDER AMENDMENTS

☐ No Changes

Required Change: _____

Representative Signature: _____ Date: _____

as Attachments to the QAPP. The LTO also describes project contacts, numbers of samples expected, report delivery dates or turn-around-times, and the required level of QC and deliverables (reportables) to be provided in the laboratory data package. The LTO is an extension of the laboratory services agreement (contract) and expresses in writing the project specific performance requirements expected of the laboratory. A copy of all submitted LTOs should be obtained when conducting CCS.

2.3 Chain-of-Custody (COC) Forms

The COC documents the actual samples that were delivered to the laboratory and the parameters requested. To be valid, COCs must have been signed by a representative of the laboratory in addition to field sampling personnel. A copy of all COCs submitted must be obtained in order to assist in evaluating the completeness of the laboratory data package and in CCS. The COC should be consistent with the LTO unless field conditions required that a deviation from the planned scope of work be made. Changes of this type should have been documented and communicated to the laboratory by field personnel by submitting an amendment to the original LTO. Copies of all documentation of this type are required. All should be signed in ink.

2.4 Project Specific Reporting Requirements

The required level of QC (Level D or Level C) should have been communicated to the laboratory prior to the start of sampling by submitting a laboratory task order. A description of the required elements of each reporting level are provided in Attachment A of the generic laboratory services agreement provided in Attachment E of this manual. The description of the QC level selected will need to be used to conduct CCS.

2.5 Project Specific Terms and Conditions

If specific terms and conditions have been arranged by project quality assurance officers or project managers with the laboratory that differ from the laboratory services agreement, a copy of this document will be needed in order to determine contract compliance and assessment of penalties to the laboratory.

2.6 Checklists, Data Validation Report Sheets and Forms

A copy of the Field Data Validation Checklist (FDVC) and one or more copies of the Master Sample List (MSL) forms will be required. Examples of these checklists and report sheets are presented as Attachment E. The special Data Validation Report Sheets (DVRS) forms required for validation are presented as Attachment G. The CCS checklist is presented in Attachment G. Copies of these forms should be made for use in validation.

2.7 Field Data Package

The field data package must be available to properly conduct data validation. The validity of the sample is as important as the analysis. Field data packages should include (where applicable) but are not limited to the following documents:

* Daily logs
* Soil boring logs
* Water sampling logs
* Air sampling logs
* Geotechnical logs
* Chain-of-Custody forms
* Field notes
* Field instrument calibration logs

* Daily quality control reports
* Laboratory task orders and amendments

Other documents that might be included are shipping records, bound field log books, health and safety log books, etc.

2.8 Analytical Data Package

The principal components of the analytical data package consist of:

1) an introductory letter and quality assurance narrative about difficulties encountered in the analysis;

2) a master tracking list that correlates laboratory sample identity codes with field sample identification;

3) the identification of the parameters (analytes) analyzed, methods of analysis, detection limits, and dates of sampling, receipt by the laboratory, sample preparation/extraction, and analysis;

4) the results of analysis of the samples;

5) signed copies of the COC forms; and

6) the (Quality Control Data package) results of analysis of quality control samples and DQO control limits specified by the laboratory QAPs.

Items 1 through 5 above are referred to as "General Information" and should be provided in every laboratory data package regardless of the level of QC requested. Item 6 refers to

the "Reportable Quality Control Data." The quantity and type of this information provided will vary in accordance with the requested QC level as identified in the QAPjP.

Guidance information and documents on data validation of inorganic and organic data for Level D and C are in Attachments B, C, and D.

3.0 FIELD DATA VALIDATION

The following discussion is a "step by step" procedure for conducting data validation of Field Data Packages.

3.1 Purpose

By the definition of the EPA, environmental samples are chemical or physical evidence collected from a site or facility that may be used in a court of law. Therefore, it is incumbent on data users to ensure that collected samples are valid. The purposes of validating the field data include:

- to determine adherence to the work plan(s), OU-specific FSPs, and the OU-specific QAPjP;
- ensure required documentation has been developed;
- verify validity and legal defensibility of the samples collected;
- identify any errors in documentation that may be corrected; and
- determine if the performed field sampling procedures will jeopardize the analytical outcome so that corrective actions may be taken to stop the analysis, if not begun or completed, and implement procedures to repeat the sampling correctly.

3.2 Changes in the Field Program

If a change in the field program occurs that is outside the planned scope of work or if procedures specified in the OU FSP are modified, a field change request form should have been completed and included in the field data package. The Sampling Alteration form is provided in the BFSP. A review of this form should be conducted to ensure the following:

- The form is completed in ink;
- filled out completely;
- appropriate signatures indicating approval of the modification has been affixed

3.3 Procedure for Field Data Package Review

The required materials for validating Field Data Packages include: the FDVC, MSL, COC forms, the QAPjP, OU FSP, QAPP, and BFSP.

3.3.1 FDVC

All requested information should be written on the checklist header. Note that only one checklist is required for the entire field data package. Consult the QAPjP and/or LTO to determine the required QC Level.

3.3.2 MSL

Using the MSL and the COC forms, prepare a master list of the samples collected. For each analytical parameter, list the samples down the left hand side (column 1, Sample ID) of the form. This list has three uses: (1) identify each sample submitted to the

laboratory; (2) evaluate the completeness of the analytical data package (analyzed samples); and (3) evaluate holding times.

3.3.3 Sampling/Drilling Records Inspection

Review drilling and sampling logs to ensure the following:

- o A log exists for each sample;
- o The log is completed in ink;
- o The information listed on the checklist is documented on each sampling log; and
- o Logs are signed and dated.

Make a check mark on the checklist in the appropriate column for each item. If any errors on logs are detected, correct the error and initial the correction. Corrections are made by drawing a line through the error and initialing. Do not use liquid paper (white out) to correct an error. Omissions or missing logs also may be corrected by filling in the required information or filling out a new form, and indicating that the record was created "after the fact". This may only be done after verifying the accuracy of the information and obtaining the signature of the sampling personnel. Note any errors identified on sampling logs that are not correctable in the comments section of the checklist. Data developed from samples collected without having acceptable documentation or where it is determined not to have been collected in accordance with the QAPjP/OU FSP may be classified as either unusable or qualitative. Reviewers must use judgement in making this determination.

3.3.4 Daily Quality Control Report (DQCR)

This form must be completed daily during each sampling event as defined in the QAPP. Review each document and ensure the following:

- A DQCR form exists for each day of activity;
- The form is completed in ink;
- The information listed is complete and accurate;
- The form is signed and dated.

3.3.5 Corrective Actions Report

During the work activities, problems that arise in the field requiring corrective actions must be documented. A Corrective Actions Form will be prepared containing the following information:

- Nature of problem is described clearly;
- An evaluation of the cause is provided, if known;
- The location of the incident (PSC, OU, etc.) is stated;
- When the problem occurred;
- Who discovered the problem;
- Corrective action taken to correct the problem;
- Who performed the corrective action;
- An evaluation of whether the corrective action will prevent the problem from re-occurring.

The document must be completed in ink, signed, and dated.

3.3.6 Organizing/Binding Field Records

Attach all logs and forms to the back of their respective COCs, arrange COCs in chronological order according to sample

collection date, assign a number (1, 2, 3, etc.) to each COC starting with the COC having the earliest sample collection date and bind all together with a plastic cover using index tabs to separate COC packages. If many COCs and sampling logs are involved, several volumes may be required. It is helpful if a table of contents is prepared for each volume. This may be easily accomplished by binding a copy of the Master Sample Lists in the front of each volume. In column 2 of the MSL the assigned number of each COC will be indicated next to each sample ID.

3.3.7 Sample Collection Date Entry

Using the MSL forms enter the sample collection date next to each sample ID in column 4 (Col. Date) and make one Xerox copy of the form for each analytical method requested to be performed by the laboratory plus extra copies for binding with the COCs as described above. For example, if VOCs by EPA Method 8240, BNAs by EPA Method 8270, Total Cyanide by EPA Method 335.2, and Total Metals by EPA Method 6010 are requested, then four copies of the MSL should be made. These forms will be used as work sheets in the next phase of validation to evaluate data package completeness and compliance with holding times.

3.3.8 Counting Samples

Using the MSL, count the number of actual samples of each matrix and parameter that were submitted. Do not include Field QC samples in this count. Field QC samples should be counted separately. Determine the number of field replicates, field blanks, rinsate blanks, and trip blanks that were submitted. Determine the percent frequency of each field QC sample for each matrix and parameter. Compare this number to the frequency specified in the QAPP. While failure to meet the frequency specified in the QAPP for analysis of field QC samples does not of

itself invalidate data, in strictly regulated investigations, it may make defense of the data more difficult. Place a check mark on the field validation checklist that field QC samples were appropriately collected and submitted for analysis. If not, indicate so by placing a number in the space provided and footnoting the deficiency in the comments section at the bottom of the checklist.

3.3.9 Field Instrument Calibration Logs

Review of all instrument calibration logs and verification that field instruments (pH meters, conductivity meters, organic vapor analyzers, HNU, TIP Meters, etc.) have been properly calibrated prior to use will be done in accordance with manufacturers specifications and consistent with requirements specified in the QAPP.

3.4 Field QC Samples Review

3.4.1 Field Blank Sample Review

This review involves an evaluation of the analytical results for all equipment rinsate blanks, field blanks, and trip blanks. An evaluation of the frequencies of collection should be completed and the associated samples should be identified.

All blanks should be free of contaminants for which they were analyzed, i.e., the results reported should be less than the required detection limits specified for the program. If detection limits in blanks are elevated, the data from the blanks should be classified as unusable.

The presence of contaminants in blanks may be a sufficient basis for classifying all associated sample results as either

qualitative or unusable. The rules governing the interpretation of blanks are contained in the EPA Laboratory Data Validation Functional Guidelines for Organics and Inorganics Analyses presented in Attachments B and C. All blanks data must be evaluated along with the sample data and judgement applied before classifying data as qualitative or unusable. The following discussion describes the evaluation and interpretation of each type of blank.

3.4.1.1 Equipment Rinsate Blanks. Equipment rinsate blanks are the most potentially compromised blank sample. These blanks are used to determine the adequacy of sampling equipment decontamination procedures. The presence of compounds of interest in the rinsate blank water in concentrations above the specified detection limits indicates potential contamination may exist in all associated samples from the following sources:

- Deionized/distilled water used for decontamination
- Decontaminating soap, or solvent
- Sampling equipment (poor contamination technique)
- Sample container bottle
- Sample preservative
- Volatile contaminant absorbed by the sample in transit from the field to the laboratory
- Laboratory contaminant

A careful evaluation of these blanks is required. Associated samples also must be determined. If contaminants are present, this information must be evaluated in terms of the other blanks data and sample data. Judgment must be exercised in determining the source of the contamination and the effects upon the samples.

3.4.1.2 Field Blanks. The presence of compounds of interest in field blanks above the specified detection limits indicates

potential contamination may exist in all associated samples from the following sources:

- o Deionized/distilled water used for decontamination
- o Decontaminating soap (if diluted with the water)
- o Sample container bottle
- o Sample preservative
- o Volatile contaminant absorbed by the sample in the field or in transit from the field to the laboratory
- o Laboratory contaminant

A careful evaluation of these blanks also is required. Associated samples also must be determined. If contaminants are present, this information must be evaluated in terms of the other blanks data and sample data. Judgment must be exercised in determining the source of the contamination and the effects upon the samples.

3.4.1.3 Trip Blanks. Trip blanks are used to evaluate the cleanliness of the volatile organic (VOC) sample containers, the presence of contaminants within the sample preservative, the presence of volatile contaminants in the cooler that sample bottles are shipped in, and the presence of volatile contaminants in the laboratory water. In summary, the presence of compounds of interest in trip blanks above the specified detection limits indicates potential contamination may exist in all associated (VOC) samples from the following sources:

- o VOC sample container bottle
- o Sample preservative
- o Volatile contaminant adsorbed by sample bottles in transit to the field or absorbed by the sample in the field or in transit from the field to the laboratory
- o Laboratory contaminant

A careful evaluation of these blanks also is required. Associated samples also must be determined. If contaminants are present, this information must be evaluated in terms of the other blanks data and sample data. Judgement must be exercised in determining the source of the contamination and the effects upon the samples.

3.4.2 Field Replicates and Field Splits Sample Review

The purpose of field replicate/splits data may be classified into two categories: (1) to evaluate the precision (reproducibility) of the sampling and analytical procedures; field replicates will evaluate intralaboratory precision and field splits evaluate interlaboratory precision; and, (2) to evaluate the degree of contaminant variability within the sample matrix.

Evaluations of replicate/split analytical precision is most practically accomplished in a water matrix because of the sample homogeneity. Evaluations of precision of replicates and split samples in a soil/sediment matrix are generally impractical due to inherent sample inhomogeneity. For soils and other solid, semi-solid or inhomogeneous matrices the replicates and splits provide an evaluation of the matrix variability in terms of variable compound concentrations. This information can be useful for engineers during remediation activities. Evaluations of precision of replicates and split samples in air matrices generally cannot be assessed because a duplicate sample of air cannot be obtained on the same equipment at the same time. However, co-located air samplers will provide a degree of reproducibility to assist in the evaluation of air samples.

In evaluating the replicate/split data, the values obtained for the replicates and splits should be tabulated alongside the associated sample results and the relative percent differences

(RPD) should be calculated. In addition, the identifications of all the samples in the same sample batch should be determined. Interpretation of the RPD values may be accomplished by employing the rules for laboratory duplicates in the EPA Laboratory Data Validation Functional Guidelines for Inorganics Analyses. However, these rules should only be used for general guidance as field QC samples cannot by themselves be used to invalidate data. In general, for inorganics analyses in water matrices, RPDs that are greater than 20 to 25 percent should be considered suspect; for organics analyses in water matrices the RPDs are to a large extent dependent upon the method and the compound being analyzed. For volatile compounds RPDs of 30 to 40 percent may be acceptable; for semi-volatiles, pesticides and PCBs, RPDs may be as much as 60 percent or greater. For inorganics or organics analyses in soil there are no RPD criteria established for field replicates and splits. RPD values of several hundred percent may be seen and the data may still be valid. Regardless of the sample matrix, evaluation of field replicates and splits should be accomplished in the light of other QC information. Judgement should be exercised.

4.0 ANALYTICAL DATA VALIDATION

4.1 Introduction

The purposes for validating the analytical data package include:

1) To verify that the laboratory has completed the scope of work as requested on the LTO and COC (this phase is referred to as Contract Compliance Screening); and to verify that specified DQOs have been met or that legitimate and scientific explanations are given that justify why DQOs were not achievable;

2) To determine the usability of the data in accordance with the DQOs specified in the QAPP, the specified analytical method and the EPA Laboratory Data Validation Functional Guidelines for Evaluating Inorganics and Organics Analyses, if applicable;

3) To determine if the laboratory has earned full compensation for services rendered or if penalties and/or a reduction in billed laboratory charges should be made; and,

4) To determine if resampling is required and whether the laboratory should be held responsible for resampling costs.

4.1.1 Qualifier Codes, Contract Compliance Screening, and Data Usability Determination

During Analytical Data Validation, a determination is made as to the laboratory's compliance with the contract requirements and the usefulness or "usability" of the data. Laboratories may not always be capable of achieving quantitative results when analyzing samples. This may be due to various factors such as analyte concentrations that require dilutions, or the presence of certain chemical compounds that interfere with the measurement of the analytes of interest, or sample matrix inhomogeneity. These interferences, referred to as matrix interferences or sample inhomogeneity, sometimes defeat the laboratory's ability to obtain the specified data quality objectives or quantitation of the analytes of interest. This type of failure may not be the laboratory's fault and it would be improper to penalize the laboratory for these instances. Generally speaking, data affected by matrix interferences or sample inhomogeneity are usually classified as qualitative data, not as unusable data.

Failure of the laboratory to meet the established control criteria for QC parameters is not acceptable if it is demonstrated to be due to a lab deficiency. Based on the QC parameter in question and the type of failure, data associated with these errors may be classified as unusable.

In order for users of the data to understand how the data may be interpreted and to determine if resampling is required, it is necessary for users of the data to understand how data is classified or qualified. Therefore, to communicate the status of the data, "Data Qualifier Codes" or "Use Codes" are applied next to the analytical result as appropriate during the validation process. Qualifier codes are applied to the affected sample data if the

associated QC data is outside the established control criteria or some other DQO has not been met.

For most data, the following qualifier codes may be used:

- R code: Data flagged with an "R" has not met the required DQOs and the analytical QC requirements. This data is unusable even if field QC data is acceptable. Resampling and reanalysis are necessary for verification of presence or absence of compound.

- J code: Data flagged with a "J" has failed some of the analytical QC requirements but not sufficient to warrant classifying the data as unusable. Data receiving a "J" flag is considered to be qualitative (an estimated value) provided the field data meets all criteria and the sample is valid. This data also is considered to be Level A data. Data that has numerous QC parameters outside acceptance criteria that each individually only warrants a "J" flag, should be evaluated for potentially being unusable and flagged with an "R". The "J" flag is also used when estimating a concentration for tentatively identified compounds (TICs) where a 1:1 response is assumed, or when the mass spectral data indicate the presence of a compound that meets the identification criteria but the result is less than the sample quantitation limit but greater than zero.

- U code: Data flagged with a "U" means the analyte was analyzed for but not detected, i.e., the analyte was below the detection limit. Often this flag is seen in conjunction with a "J" flag. Care should be exercised in evaluating functional guidelines in Attachments B and C. The sample quantitation limit must be corrected for dilution and for percent moisture.

- B code: Data flagged with a "B" code means that the analyte was present above reporting detection limits within associated laboratory blanks; It indicates possible/probable blank contamination and warns the data user to take appropriate action. This flag must be used for a TIC as well as for a positively identified compound. B codes do not necessarily invalidate the data but are dependent upon the judgement of the reviewer in applying the validation guidelines;

- C code: This flag applies to pesticide results where the identification has been confirmed by gas chromatography/ mass spectrometry. Single component pesticides > or = 10 ng/ul in the final extract must be confirmed by GC/MS.

- E code: In organics analysis, this flag identifies compounds whose concentrations exceed the calibration range of the GC/MS instrument for that specific analysis. This flag will <u>not</u> apply to pesticides/PCBs analyzed by GC/EC

methods. If one or more compounds have a response greater than full scale, the sample or extract must be diluted and reanalyzed. If the dilution of the extract causes any compounds identified in the first analysis to be below the calibration range in the second analysis, then the results of both analyses shall be reported.

In inorganics analysis, this flag means the reported value is estimated because of the presence of interference. An explanatory note must be included under Comments on the cover page, if the problem applies to all samples, or on the specific FORM I - IN, if it is an isolated problem.

- D code: This flag applies to organics analysis only; identifies all compounds identified in an analysis at a secondary dilution factor. If a sample or extract is reanalyzed at a higher dilution factor, as in the "E" flag above, the "DL" suffix is appended to the sample number on the Form I for the diluted sample, and all concentration values reported on that Form I are flagged with the "D" flag.

- A code: This flag indicates that a TIC is a suspected aldolcondensation product.

- X code: This flag means that other specific flags and footnotes may be required to properly define the results. If used, they must be fully

described and such description attached to the Sample Data Summary Package and the Case Narrative. If more than five qualifiers are required for a sample result, use the "X" flag to combine several flags, as needed. For instance, the "X" flag might combine the "A", "B", and "D" flags for some sample.

- Q code: No analytical result.

- M code: (For inorganic analysis only); Duplicate injection precision not met.

- N code: Spiked sample recovery not within control limits.

- S code: The reported value was determined by the Method of Standard Additions.

- W code: Post digestion spike for Furnace Atomic Absorption analysis is out of control limits (85 to 115 percent), while sample absorbance is less than 50 percent of spike absorbance.

- * code: Duplicate analysis not within control limits.

- + code: Correlation coefficient for the Method of Standard Addition is less than 0.995.

- No code: Data that meets all DQO criteria is considered to be quantitative. This data is also Level B data. No codes are applied.

Other codes may also be seen in data packages (particularly CLP protocol) where the laboratory has flagged the data by computer. However, validation and qualification of data with the previously discussed "Use Codes" may be effectively accomplished without using these extra codes.

If it is determined that any data requires codes to be applied, such shall be indicated on the DVRS forms, giving the identification of the samples and parameters affected. Subsequent use of that data in reports, figures, and tables must include the data qualifier code.

4.1.2 Data Usability Levels

For simplicity of discussion and engineering, it is often convenient to refer to the data from various matrices (soil, sediment, ground water, surface water, etc.) as qualitative, quantitative, or unusable. Obviously, within any matrix it is likely that certain samples may have parameters that require qualifier codes. These data must be individually identified. However, the remaining sample data (without any qualifier codes) may be generally classed as either Level A (qualitative), Level B (quantitative), or unusable. Further explanation of each level is provided below.

Level A Data: This data is qualitative (estimated). Generally, this data has been flagged with a "J", "UJ", "E", "M", or "N" code. To be usable, data in this level must have met all the requirements specified in the field checklist and CCS and at least some of the analytical QC data. Any sample data receiving an "R" qualifier code or an unexplained "B" qualifier code may not be classified as Level A data. Data that has been given a "J" code may not be considered as Level B data. Data of this type (Level A) may be used to evaluate presence or absence of chemical compounds

and to help design additional sampling and analysis programs. This data should not be used for designing remediation systems.

Level B Data: This data is quantitative. Data at level B must have met all the requirements specified in the field checklist and on the appropriate DVRS forms. This data may be used for any purpose.

Unusable Data: Data in this category has failed the requirements within the field checklist and/or the DVRS forms. This data should be flagged with an "R" and may not be used for any purpose.

Analytical data that was given "J" or "U" flags must be acceptable at Level A (qualitative) in order to be usable. Remember it may be flagged "J" during analytical data validation but may have been classified "unusable" during the review of field data. "J" flagged data, however, may not be considered for classification to Level B (qualitative and quantitative). Only data that was found to be analytically valid and passed all criteria for Level A may be considered for classification at Level B. As with Level A, all control criteria in Level B is required to be met or failures adequately explained; if not, the data for a given sample or sample matrix may not be classified for use at Level B. Only data meeting all field and analytical data validation requirements may be classified as Level B data to be used for qualitative and quantitative purposes.

During the validation process, the reviewer of the data must keep in mind that all data should be quantitative regardless of the analytical level of reporting. However, based on the level of reportables prescribed for the particular site, the quantity of QC data to be reviewed for analytical validation may vary from one PSC to another. Therefore, since the degree of validation is less

rigorously supported at lower reporting levels, the data is considered valid if all of the required reportables specified by the laboratory task order have been submitted and satisfactorily completed (i.e., the QC data are within acceptable control limits). If any QC data are not within specified control limits, the reviewer is obligated to request additional data from the laboratory to determine the cause of the discrepancy, if possible. If the discrepancy cannot be resolved and the reviewer believes the discrepancy significantly affects the qualitative or quantitative data validity, the appropriate qualifier codes and level classification of the data must be determined as indicated by the checklist and in accordance with the method criteria and/or the EPA Functional Guidelines. In this manner, the lower levels of QC act as a screening process that reduces the time to conduct data validation.

4.1.3 Analytical Data Package Review

4.1.3.1 Required Tools. Obtain the laboratory data package and the appropriate (organic or inorganic) DVRS forms. Also, obtain a copy of the validation functional guidelines for organics, pesticides, inorganics, or Level C as appropriate (Attachments B, C, and D of this manual), a copy of the appropriate QC Level deliverable requirements (Attachment A), or from the AQA/LCP (Attachment A of Attachment E of this manual), COC forms, laboratory task orders, specific terms and conditions (if defined) and any other documents used in requesting laboratory services.

4.1.3.2 Chain-of-Custody Review. Review each COC for completeness, accuracy and agreement with the methods specified in the QAPP and on the LTO. Ensure that each COC has been signed and dated by the field personnel and the laboratory sample custodian or representative.

4.1.3.3 Master Sample Tracking List Review. Locate the master sample tracking list provided in the laboratory data package. If a list has not been provided by the laboratory then you must prepare a list of samples analyzed by the laboratory from information provided in the laboratory data package. Failure to provide a master tracking list does not invalidate data. This is a minor data package incompletion. Judgement should be exercised to determine if it is truly needed.

Compare the laboratory master sample tracking list with the Master Sample List you prepared during Field Data Validation to verify that all samples submitted were received and accounted for by the laboratory as being analyzed. This step does not completely verify that analysis was completed. You also must review the individual sample results contained in the laboratory data package and verify that each sample submitted was analyzed as requested and the results reported.

4.1.3.4 Reorganize the Laboratory Data Package. Considerable variation exists among laboratories in the formatting of data packages. However, most laboratories divide data packages into sections as described in Section 2 of this manual. Therefore, organize the reported data so that "like" matrices (soil, air, water) are combined together by "like" parameters and methods, i.e. into analytical batches. By doing this, it is possible to associate the pertinent analytical quality control data contained in the QC section of the data package with each analytical sample batch. To organize the data package in this manner, the following nine steps are recommended:

1. Separate the laboratory data package into the following report sections:

   - o Narrative summary and Master tracking list,
   - o Sample results (including raw data),
   - o Quality control data (including summaries and raw data),

- Chain-of-custody forms - COCs should have already been removed for validation of the Field Data package.

2. Separate sample results by matrix as follows:

   - Water samples (ground water, surface water, leachate, etc.),
   - Soil samples (soils, sediments, sludges, etc.),
   - Air

3. Separate sample results in each matrix by specific test methods. For example: suppose parameters requested include VOC, BNAs in water, and BTEX in soil. Arrange data by placing all VOC analyses by EPA 624 together, all BNA analyses by EPA 625 together, and all 8020 analyses together, etc. Be sure to keep water and soil methods separate.

   Note that results of some test methods are reported on the same report form. This should not be a problem because usually these results are from the same section of the laboratory. Laboratory sections from which data reports originate may include:

   - Inorganics analysis: Wet Chemistry Methods, e.g., alkalinity, acidity, nitrate, nitrite, sulfate, sulfide, chloride, total dissolved solids, fluoride, dissolved oxygen, total hardness, BOD, COD, TOC, TRPH, TRP, total cyanide, etc.,
   - Inorganics analysis: Metals analysis,
   - Organics analysis: Gas chromatography, volatiles, extractables (PNAs, Phenols, etc.)
   - Organics analysis: Gas chromatography, and HPLC, Pesticides, PCBs

- o Organics analysis: Gas chromatography/mass spectrometer, volatiles and semi-volatiles

4. Arrange sample results for each method and matrix in chronological order according to the date of analysis. Staple each method group together to form a subdata package.

   Based on the number of analyses requested for each sample, one or more groups of sample results will be arranged chronologically with each group being for the same analytical method.

5. Form the Organics Analyses (VOAs, Semi-VOAs, Pesticides/PCBs) into a single group separated by title sheets into sections based on the parameter/method. Attach a set of organics DVRS forms for organics to this group.

6. Form the Inorganics Analyses (metals and cyanide) into a single group separated by title sheets into sections based on the parameter/method. Attach a set of inorganic DVRS forms to this group.

7. Form the Wet Chemistry Analysis (except for cyanides) into a single group separated by title sheets into sections based on the parameters/method. Attach a set of inorganics DVRS forms and the Wet Chemistry checklist to this group.

8. Separate the quality control data package by matrix, method, and QC parameter and combine this information with the applicable group of sample results. Attach the appropriate DVRS form to its respective QC parameter data.

   Generally, QC data is identified by QC parameter and analytical method. For example: In a water matrix analyzed

for volatile organic compounds, the matrix spike might be the QC Parameter; Method 624 might be the method.

In addition, laboratories also should identify the samples to which the QC data is applicable. This may be accomplished in a variety of ways, e.g., analysis dates, code numbers,etc. After identifying QC parameters, separate QC data and place it with the appropriate analytical sample/parameter batch. This procedure should be continued for each analytical parameter until all QC data has been sorted and placed with the applicable samples. In order to help minimize confusion, a glossary of the most common acronyms, terms and abbreviations is provided with definitions in this manual.

Data reviewers should review the DVRS forms. Note the different types of QC parameters to be evaluated. Two lists are presented below which summarize the expected QC parameters to be provided with most CLP data packages for organics or inorganics analyses.

QC parameters for organics include the following:

- Holding times
- GC/MS Tuning and Performance
- Pesticides/PCBs Performance
- GC/MS Calibration (initial and continuing)
- Pest/PCBs Calibration
- Method Blanks
- Field Blanks
- Trip Blanks
- Surrogate Recovery
- Matrix Spike/Matrix Spike Duplicates
- Field Duplicates
- Internal Standards

- Compound Identification
- Compound Quantitation and Detection Limits
- Tentatively Identified Compounds

Additional QC Parameters for Non-CLP Organics include the following:

- GC calibration (initial and continuing)
- Calibration factor (external calibrations) determination
- Response factor (internal calibration) determination
- Reagent water (blank) spikes
- Reagent water (blank) spike duplicate

The following is a list of QC Parameters for inorganics:

- Holding times
- Calibration curve standards
- Initial calibration verification standards
- Continuing calibration verification standards
- Method blanks
- Field blanks
- ICP interference check sample
- Laboratory control sample
- Laboratory duplicates or matrix spike duplicate
- Matrix spike
- Furnace AA QC (method of standard addition) and dual injections (for CLP)
- ICP serial dilutions check sample
- Linearity check samples (ICP)
- Result verification
- Field duplicates

Also note that the presentation of the QC data will vary from one laboratory to the next. Except for the EPA Contract Laboratory Program (CLP) reporting format, there are no standardized formats for reporting QC data. Laboratories should use the CLP format for Level D Deliverables and some Level C Deliverables, but these report forms are only applicable to the following methods:

- Volatiles by CLP-624-Mod
- Semi-volatiles by CLP-625-Mod or 8270
- Pesticides/PCBs by CLP-608-Mod or 8080
- Metals by ICP, AA (flame or furnace)
- Cyanide by manual distillation (CLP-239.2-Mod)

The contract laboratories will also generally use these forms for the non-CLP type programs involving these methods. This is acceptable.

9. Obtain the analytical DVRS forms as needed for each sub-data package and QC parameter. After sorting the data as described above and depending upon the size of the analytical program, you will have one or more sub-data packages to validate.

   For example, in a single laboratory data package for analysis of a water matrix, there may be a sub-data package of volatile organic analyses by EPA Method 624, another sub-data package for base/neutral and acid extractable analysis by EPA Method 625, and another sub-data package of Total Metals Analysis for Lead by EPA Method 239.2. Each of these sub-data packages should have one or more sample results and the associated QC data. Each of these sub-data packages must be individually validated.

4.1.4 CCS - General Information Review

A fundamental part of data validation is contract compliance screening. The purpose of this screening is to determine if the laboratory has fulfilled its contractual obligations by providing a data package that is complete, competent, responsible, and meets DQOs.

One component of the required deliverable data that should be specified in the laboratory services agreement may be called "General Information." CCS requires that a check be made to ensure that all required information has been submitted. This section (General Information) of the CCS Checklist is the same at all levels of QC.

During CCS, the general information that is reviewed includes the following:

- Narrative summary,
- Sample results,
- Parameters and methods of analysis,
- Detection limits,
- Sample preparation and analysis data and analytical holding times,
- QC data package summary and raw data.
  - Summary
  - Raw Data

The data package must be reviewed initially to ensure all of the components have been properly submitted.

The following discussion is a step-by-step review of the required general information. A CCS Checklist is provided in Attachment G.

4.1.4.1 Narrative Summary. Read the laboratory's narrative summary report provided in the data package. This may simply be a letter or a formal written report which documents any QC problems encountered by the laboratory during the analysis of the samples. This information will help you to focus your evaluation on problem areas. However, these are not the only problems that may exist. You may find additional problems. Note compliance with CCS on the CCS Checklist (Attachment G).

4.1.4.2 Sample Results. Check each sub-data package to ensure that all requested sample results for each method have been provided. Missing results constitute incomplete reports. See Section 6 (Resolving Problems) for further information. Note CCS Compliance on the CCS Checklist (Attachment H).

Prepare a spread sheet of the analytical results for each sample. This is especially helpful when evaluating samples analyzed for organic parameters to evaluate potential "carry-over contamination" from sample to sample. It is also helpful when conducting statistical analysis (T-tests) of the data or comparing to historical results.

4.1.4.3 Parameters. Check each sub-data package to ensure that all samples were analyzed for the requested parameters (analytes). For example, various organic analyses (VOCs, BNAs, Pesticides, BTEX, etc.) involve many compounds. However, it is important to check that the laboratory has analyzed and reported the compounds specified in the QAPjP and requested in LTOs. This check also should be performed on "single" parameter analyses. Missing results constitute incomplete reports. See Section 6 for further information. Note CCS compliance on the CCS Checklist (Attachment G).

4.1.4.4 Methods. Check each sub-data package to verify that samples were analyzed by methods specified in the QAPjP and requested on LTOs. Note CCS compliance on the CCS Checklist (Attachment G).

Typographical errors or misstatements of methods should not be overlooked. The laboratory has a responsibility to provide accurate information. If the method reported is different than the method requested but the analytical results and parameters are consistent with desired information, contact the laboratory to verify that the error is a typographical error or misstatement and that the correct method was actually used to analyze the samples.

If it is determined that the laboratory actually failed to use the correct method, then the QAPjP has been violated, the LTO (contract) has been breached, and the DQOs may not have been achieved. Data reviewers must use their judgment and determine if sufficient sample is available at the laboratory for re-analysis and if enough holding time remains to constitute the re-analysis by the correct method as valid or determine if resampling and re-analysis is required.

4.1.4.5 Detection Limits. Check each analytical report for each sample in each sub-data package and verify that the detection limits are appropriate and consistent with the requested detection limits. Note CCS compliance on the CCS Checklist (Attachment G).

The evaluation of detection limits as they pertain to common laboratory contaminants is always a perplexing problem. To begin, one must first understand the difference between a method detection limit (MDL) and instrument detection limits (IDL). The American Chemical Society (ACS) defines each as follows:

MDL: The MDL is the lowest concentration of analyte that an analysis method can detect reliability in either a sample or blank, i.e., the analyte can be measured above background noise, after the sample or blank has been put through some type of preparatory procedure (method) prior to analysis on some instrument. Hence we get the terms "method blank" and "method" detection limit.

IDL: The IDL is the smallest signal above background noise that an instrument can reliably detect, regardless of whether it is a sample or a blank. In other words, it is a measure of how low the instrument is capable of measuring reliably, e.g., distinguish the difference between an instrument electrical response due to voltage fluctuations and a response due to the presence of an analyte in the sample matrix.

It can be seen that if an analyte is measured in a sample matrix which does not require a prior preparatory procedure, such as occurs with analysis of volatile organic compounds in a water sample, it is possible that the reported MDL could be equivalent to the IDL. MDLs allow for the failure of the preparatory method to recover all of the analyte within the sample matrix. Hence, MDLs are generally a higher value than IDLs.

The procedure for the determination of MDLs and IDLs is essentially the same. EPA requires that MDLs for organics be determined statistically according to the procedure specified in 40 CFR Part 136, Appendix B and also in the U.S. EPA Contract Laboratory Program (CLP) Statement of Work, July 1985 Revision. These procedures require the analyst to perform three (CLP requirement is three, 40 CFR requirement is seven) analyses of standards (prepared from standard reference materials) for each analyte being measured at 3 to 5 times the required detection limit concentrations specified by the CLP statement of work (40 CFR

simply uses the estimated instrument detection limit published with the method). These analyses are required to be performed using the instrumental conditions specified for the analysis on standards in solvent for base, neutral, and acid extractable organic compounds, PCBs, and pesticides and on standards diluted into reagent water for volatile organic compounds. The MDLs or IDLs are calculated as three times the standard deviation of the measured value (40 CFR multiplies the SD times a student's T-test value provided in a table with the procedure for the number of degrees of freedom involved).

For inorganics analysis, the MDL or IDLs are determined using the procedure specified in the U.S. EPA CLP Statement of Work, July 1985 Revision of inorganics analysis. This method requires the MDL or IDL to be determined by multiplying by 3, the average of the standard deviations obtained on three nonconsecutive days from the analysis of a standard solution (each analyte in reagent water) at a concentration 3 to 5 times the estimated detection limit for the method with seven consecutive measurements made per day.

According to the ACS, if one multiplies the average standard deviations obtained by these procedures by a factor of 5 to 10 then the value obtained may be considered the limit of quantitation (LOQ). CLP defines contract required quantitation limits (CRQLs). However, CRQLs may not be applicable for the Clean Water Act or the Safe Drinking Water Act because they may be too high in some cases to meet standards. RCRA also has recognized the need for LOQs and has developed a detection limit called a PQL or practical quantitation limit. This is actually an LOQ or MDL with consideration given for the matrix type. PQLs will generally be used in this project and are referenced where possible in Attachments A, B, and C to the QAPP.

4.1.4.6 Dates and Holding Time. Review the sample results in each sub-data package and determine from the report the sample receipt data, sample preparation or extraction data, and the sample analysis date. Record these dates under the designated columns on the master sample list prepared during the field data validation process. You will need one master sample list form for each analytical method requested. Also record the required holding time, from Task 1 of the QAPP, on the master sample list where indicated. Using the date information, determine the holding time to sample preparation/extraction and sample analysis. Record this time on the MSL where indicated. Note CCS compliance on the CCS Checklist (Attachment G).

If the holding time was exceeded, the data for the analysis of the sample in question must be qualified and appropriately flagged. The reviewer is referred to Attachments B and C of this manual for the Laboratory Data Validation Functional Guidelines for organics or inorganics analysis for further instructions on how to evaluate holding times.

4.1.5 Usability Determination

The review of the QC data requires the use of the Laboratory Data Validation Functional Guidelines (Attachments B, C, and D), the description of the "deliverables" requirements for the specified level of QC from Attachment A of this manual, and the appropriate DVRS forms with QC data and the QAPP/DQOs. The evaluation process involves a review of both field QC samples and analytical QC samples.

4.1.5.1 Field QC Samples. Most field QC samples include equipment rinsate blanks, field blanks, trip blanks, and field replicates. Additional field QC samples may include field splits, and field spikes. Blanks are evaluated to test for external

sources of contamination that may have compromised the analytical data. Any field blank is evaluated in the same manner as laboratory blanks (see Functional Guidelines and Detection Limit Review discussed earlier). Other field QC samples are evaluated as measures of accuracy and precision. However, these samples are not of themselves capable of invalidating data. They should rather be evaluated and used as additional data to supplement the evaluation of the analytical data.

4.1.5.2 Analytical QC Data. The review of the analytical QC data is accomplished by applying where applicable the criteria established in the Data Validation Functional Guidelines and the precision and accuracy statements (control limit ranges) provided with the QC data submitted in the analytical data package. Control limits provided by the laboratory must be consistent with EPA criteria established for the method, or the DQOs specified in the approved QAPjP. The level of QC defines the required QC parameters to be evaluated and the DVRS forms identify the specific QC data criteria to be met.

Some laboratories may provide more data than requested. This is acceptable. Other laboratories will provide less than requested. This is not acceptable and the report should be classified as incomplete. See Section 6 for further information about incomplete reports.

Using the DVRS forms and the described deliverables, evaluate the QC data against the control criteria established by the laboratory and the criteria established in the data validation functional guidelines.

As each QC parameter is reviewed, make a check mark on the DVRS form and the CCS Checklist to indicate the required reportable

was provided in the data package, and the quality of the QC parameter was acceptable (i.e., within the established criteria).

After DVRS forms are completed as appropriate, complete the Data Validation Coding form to summarize data that has been flagged with data qualifier codes and determine the data usability level.

4.1.5.3 Data Validation Coding. The Data Validation Coding form (Attachment I) is used to apply data qualifier codes to individual analytes determined during the review process to have had quality assurance failures. These failures consist of deviations from the criteria established for the EPA method being reviewed and/or the laboratory Data Validation Functional Guidelines presented in Attachments B, C, and D. The definitions of each qualifier code are presented in Section 4.1.1.

Data receiving one or more of the qualifier codes should be identified. Both the sample identification and the specific analyte(s) that have been qualified should be described in the appropriate boxes indicated. In addition, an explanation for the qualification should be given at the end of the page. Finally, the coding form should be signed by the person performing the data review and then signed by the Quality Assurance Officer and dated.

4.1.5.4 Data Usability Classification. This form is optional. The purpose of this form is to classify each sample matrix in accordance with its data usability. Data in each sample matrix may be classified as unusable, qualitative (Level A data) or quantitative (Level B data) as explained earlier in Section 4.1.2. The purpose of this classification is to permit the determination of compliance with the representativeness DQO. For example, an engineer who requires a completeness DQO of 90 percent for all soil samples at a site in order to establish that the data is representative, might have 100 samples collected and analyzed. If

10 of these samples had QA failures, the engineer would have achieved the required 90 percent DQO because the other 90 samples had no failures. Based on this finding, the engineer should say the "soils" data was quantitative and met the "representativeness" DQO and re-sampling was not required. Completion of the form is self-explanatory. Samples having no flags or codes are not listed and the data for the matrix is classified as Level B. If, in a group of samples collected from the same matrix type, e.g., soil some of the samples have data with qualifier codes ("U", "J", "R", etc.) applied because of QA failures, these samples are separated from the total group of samples and are identified in the table. These samples are classified according to the qualifier codes applied to the individual analytes in Section Five. The remaining unqualified data is classified as Level B. Data receiving an "R" code is classified as unusable; "J" or "U" or "U/J" coded data are classified as Level A.

5.0 QUALITY ASSURANCE REPORTS

5.1 Monthly Progress Reports

During the course of field investigations the Contractor will communicate the status of the project work to the Navy Project Manager. This communication will be accomplished by submittal of a monthly progress report (MPR). Submittal of Laboratory Quality Control Data and Quality Assurance Progress Reports will not be required with the MPR. All analytical quality control data required to be submitted will be included in the final quality control summary report.

5.2 Quality Control Summary Report

The Quality Control Summary Report (QCSR) is the final QC data report. The report will be submitted at the end of the project three weeks prior to submittal of the final report for the RI/FS. Included in the QCSR will be the following:

For Level D QC, a subset of data from the CLP data packages shall be submitted. This subset shall consist of a full CLP data package deliverable for 20 percent of the water and 20 percent of the soil samples.

For Level C QC, all of the deliverables presented in Attachment A will be presented.

Also included in the report will be the following information:

- Site names, PSC numbers, and contract numbers;
- Numbers, types, and locations of samples collected and analyzed;

- Data for blanks, spikes, laboratory duplicates, and controls;
- New methods used for analysis and changes in old methods;
- Copies of all control charts pertinent to Navy samples and to which results have been added over the reporting period;
- Summaries of out-of-control incidents during the reporting period, including references to documentation and corrective action reports;
- Descriptions of and justifications for significant changes in the QA procedures;
- Changes in the laboratory QA personnel or other key technical personnel;
- Completed sample data.

The QCSR will also indicate the duration and location of storage for the data. The stored data consists of all raw data, QC charts, corrective actions reports, logs, sample lists, COC information, notebooks, work sheets, automated data processing system output and calibration data. The outline for the report submittal is given below.

QCSR OUTLINE

1.0 Project Description

1.1 Scope of Work

1.2 Background

1.3 Project Objectives

1.4 Project Organization and Responsibility

2.0 Field Operation Procedures

2.1 Geophysical and Geotechnical Procedures

2.2 Soil Boring and Monitor Well Installation

2.2.1 Equipment Calibration and Maintenance

2.2.2 Problems Encountered and Corrective Action

2.3 Soil, Sediment, Ground-Water, Surface water, and Air Sampling Procedures

2.3.1 Equipment Calibration and Maintenance

2.3.2 Sample Handling and Custody

2.3.3 Problems Encountered and Corrective Action

2.2.3.1 Sampling Handling and Shipping

2.2.3.2 Field Measurements

2.4 OU-Specific Changes to the Proposed Drilling and Sampling Program

3.0 Results of Laboratory and Field Analyses

3.1 Field Analytical Results

3.2 Laboratory Analytical Results

3.2.1 Laboratory Methods

3.2.2 Summary of Laboratory Results

3.2.3 Evaluation of Detection Limits

4.0 Data Validation and Usability Determinations

4.1 Summary Report of Combined Field and Analytical Data Validation and Contract Compliance Screening

4.2 Validation of Field Procedures

4.2.1 Sample Preservation/Handling Procedures

4.2.2 Field Records Review

4.2.3 Results of Field Blanks (Organic and Inorganic DVRS Forms 7 and 5, respectively)

4.2.3.1 Equipment Rinsate Blanks

4.2.3.2 Field Blanks

4.2.3.3 Trip Blanks

4.2.4 Replicate (Duplicate) Samples (Organic and Inorganic DVRS Forms 12 and 13, respectively)

4.3 Validation of Laboratory Procedures and Contract Compliance Screening (CCS Checklist and DVRS Forms)

4.3.1 Holding Time compliance (Org/Inorg/DVRS Form 1)

4.3.1.1 Organics

4.3.1.2 Inorganics

4.3.1.3 Wet chemistry

4.3.2 GC Calibration Data

4.3.3 GC/MS Tuning Data (Org-DVRS Form 2)

4.3.4 Pesticide/PCB Instrument Performance (Org-DVRS Form 3)

4.3.5 Initial and Continuing Calibration Results

4.3.2.1 Organics (DVRS Form 4)

4.3.2.2 Inorganics (DVRS Form 2/3)

4.3.2.3 Wet Chemistry (Inorg-DVRS Form 2/3 Checklist

4.3.6 Pesticide/PCBs Calibration (Org-DVRS Form 5)

4.3.7 Laboratory Method Blanks

4.3.3.1 Organics (DVRS Form 6)

4.3.3.2 Inorganics (DVRS Form 4)

4.3.3.3 Wet Chemistry (DVRS Form 4)

4.3.8 Trip Blanks (Org DVRS Form 8)

4.3.9 ICP Interference Check Samples (Inorg DVRS Form 6)

4.3.10 Laboratory Control Samples (LCS) (Inorg DVRS Form 7)

4.3.11 Laboratory Duplicates (Inorg DVRS Form 8)

4.3.12 Surrogate Recoveries

4.3.12.1 GC (Org. DVRS Form 9/10)

4.3.12.2 GC/MS (Org. DVRS Form 9)

4.3.13 Matrix Spike/Matrix Spike Duplicates

4.3.13.1 Organics (DVRS Form 11)

4.3.13.2 Inorganics (DVRS Form 9)

4.3.13.3 Wet Chemistry (DVRS Form 9)

4.3.14 Furnace AA QC (Inorg-DVRS Form 10)

4.3.15 ICP Serial Dilutions (Inorg-DVRS Form 11)

4.3.16 Sample Result Verification (Inorg-DVRS Form 12)

4.3.17 Internal Standards Performance (Org-DVRS Form 13)

4.3.18 Compound Identification (Org-DVRS Form 14)

4.3.19 Compound Quantitation and Reported Detection Limits (Org-DVRS Form 15)

4.3.20 Tentatively Identified Compounds (Org-DVRS Form 16)

When all of the checklists (CCS Checklist, DVRS Forms, and the Wet Chemistry Checklist) have been completed, these forms and the associated raw and reduced data (sub-data) packages for each of the

DVRS forms are combined together, separated by tabs, in the order presented in the above outline. Problems identified on each of the DVRS forms are then described and summarized in a brief report. In this report, samples with analytes that have been qualified during the validation review are tabulated. The validation summary is presented in the report in front of the DVRS forms and the supporting raw and reduced data.

6.0 RESOLVING PROBLEMS

The Laboratory Services Agreement/Subcontract should contain certain stipulated financial penalties and financial loss recovery procedures that may be applied for laboratory failures based on the results of the data validation. The laboratory failures typically provided for in the contract are described below.

6.1 10 Percent Penalties. See Section 1, paragraph 5 of the Laboratory Services Agreement (Appendix 5.2 of Volume 5.0). Applied to the following laboratory failures:

(1) Late delivery of laboratory data packages (LDPs); i.e., delivery of the data package after the agreed-upon due date.

(2) Delivery of incomplete LDP;

(a) If the LDP is delivered exactly on time or late, the report is considered to be late because the LDP cannot be completed on time;

(b) If the LDP is delivered early, the laboratory should be notified of the incompletion and be allowed to correct the submittal.

(3) Delivery of Incompetent (Inaccurate) LDPs;

(a) LDPs must be free from inaccuracies; if not, LDPs may be classified as incompetent (inaccurate); inaccuracies that may result in a report being classified as incompetent are:

1. Substantive typographical errors and misspellings;

2. Substantive misstatements of methods, parameters, dates of preparation or analysis, sample ID code, data or absence of concentration units, or misstatements of concentration units or detection limits;

3. QA data is not applicable to the analyses requested;

4. Report format is so disorganized as to be incomprehensible.

(b) If any of the above situations exist and the LDP submittal has been delivered early, contact the laboratory, describe the deficiency, and allow the lab time to correct the error. The resubmittal must be received by the required due data.

(c) If any of the above situations exist and the LDP has been delivered exactly on time or late, apply a penalty and request the lab correct the errors and submit a new report.

(4) Delivery of Irresponsible LDPs;

(a) LDPs must not contain unrequested data or unrequested interpretations of the requested data; if so, LDPs may be classified as irresponsible.

(b) If an LDP is irresponsible and the LDP has been delivered early, allow the lab time to correct the error. The resubmittal must be received by the required due date. If received late, apply a penalty.

(c) If an LCP is irresponsible and the LDP has been delivered exactly on time or late, apply a penalty and make the lab correct the errors.

Date reviewers, project manager, and quality assurance officers are cautioned to observe the following:

- Do not apply any penalties, withhold any payment approval, or bill for sample recollection, etc., without first obtaining approval from the Analytical QA Officer/Laboratory Contracts Manager.

- Review data packages immediately upon receipt to check for completeness. Failure to review data packages for completeness within fifteen days of receipt may make it difficult to apply penalties, particularly if the LDP was delivered early.

- Care and judgment should be exercised when applying penalties. If the Contractor has not been damaged, the penalty usually will not be applied. Good relations with the laboratory are extremely important; penalties applied unnecessarily may compromise an otherwise good relationship.

- The typical penalty is obtained by subtracting the penalty from the applicable invoice, and documenting on the invoice the reason for the deduction. Notification to the laboratory is also appropriate.

- If any of the above-described situations occur, do not pay invoices until the corrected LDP has been received.

- Usually penalties are not cumulative, even if more than one problem exists with the LDP. This rule does not apply to charge-backs, no payments, or resampling costs.

6.2 Charge-Backs and No Payments

(1) The Contractor may bill those costs (fees and expenses) incurred by that result directly from the Contractor's efforts of to have the laboratory correct incompetent, incomplete, or irresponsible LDPs.

(2) The laboratory is required to pay any fines or penalties incurred directly or indirectly resulting from the failure of the laboratory to meet the delivery requirements.

Likewise the Contractor is required, in those instances where the Contractor is aware that a potential fine or penalty may arise as a direct or indirect result of the late delivery of LDPs, to make all reasonable efforts to inform the laboratory of the potential amount of the fine or penalty prior to sending any samples.

(3) Costs for analytical data that has failed to meet specified Data Quality Objectives (DQOs) on Laboratory Task Orders (LTOs) should not be paid at all. These failures include:

- o Exceeding required/specified holding times;
- o Analysis by wrong method;
- o Analysis of incorrect parameters (analytes);
- o Requested detection limits were not provided and sample conditions did not preclude their being obtained;
- o Lab reports are incompetent, incomplete, or irresponsible and have not been corrected;
- o Required QA performance requirements have not been met and data is classified or qualified as UNUSABLE ("R" code) during the data validation process due to failure to meet QA performance criteria.

6.3 Resampling Costs

(a) If the Contractor determines that analytical results are unusable for any laboratory failure or the reasons cited in paragraph 3 above, and the laboratory is unable to correct the deficiencies, the laboratory will be required to pay the Contractor any reasonable costs associated with or caused by the need for recollection of samples.

(b) If the QAO and/or project manager determine that resampling is required, the following should be done:

(1) Do not pay for the unusable data;
(2) Determine the estimated costs for resampling as exactly as possible;

(3) Prepare a cost breakdown - include cost for time to prepare cost estimate. Cost estimate should include all costs plus multiplier fee.

(4) Contact the responsible person (director or manager) at the laboratory by telephone and discuss the costs. Allow the laboratory the right to negotiate the costs. Seek an agreeable compromise over the phone.

(5) Submit the negotiated cost breakdown to the laboratory with a letter documenting the phone conversation and agreements. Request the laboratory to sign the agreement and return it to you.

(6) Set up a new project number in the amount of the resampling costs. All billing for the resampling should be to this number.

(7) If the data from the resampling is valid, then the Contractor should pay for that data.

GLOSSARY OF TERMS

ACCURACY - A DQO; refers to the ability to obtain a result that is equal to or approximates the true value of the measured parameter; statistically represented by percent recovery (%R) and standard deviation of the error from the mean value (expressed as a control limit range) and percent difference (%D) from true value.

ALIQUOT - a measured portion of a sample taken for analysis.

"BATCH" - pertains to a group of samples from the same of different sources, analyzed for the same parameter by the laboratory at the same time, i.e., analysis batch.

"BATCH SPECIFIC" - pertains to a procedure (quality assurance or other) being applied to any sample within an analysis batch without regard to the sample selected for the procedures, e.g., matrix spikes.

BLANK - see Method Blank.

4-BROMOFLUOROBENZENE (BFB) - compound chosen to establish mass spectral tuning performance for volatile analyses.

CALIBRATION CHECK COMPOUNDS (CCC) - target compounds used to evaluate the calibration stability (precision) of the GC/MS system. Maximum percent deviations of the CCCs are defined in the EPA CLP SOW.

CHARACTERIZATION - a determination of the approximate concentration range of compounds of interest used to choose the appropriate analytical protocol.

CLP - Contract Laboratory Program (EPA)

COC - Chain-of-Custody form

COMPLETENESS - a DQO; the percentage of valid (within control limits) quality assurance parameters (e.g., matrix spikes, surrogate spikes, laboratory duplicates, laboratory control samples, etc.) out of the total analyzed; completeness is computed for each quality assurance parameter.

CONFIRMATION ANALYSIS - see Primary Analysis.

CONTRACT LABORATORY PROGRAM (CLP) - The EPA contractor laboratory program.

CONTRACT REQUIRED DETECTION LIMIT (CRDL) - The detection limit specified by the services agreement. Also used by the EPA CLP.

CONTINUING CALIBRATION - Analytical standard run every 12 hours to verify the calibration of the GC/MS system.

CONTINUING CALIBRATION VERIFICATION STANDARD (CCVS) - Aqueous standard of known concentration used in inorganic analysis to verify continuing calibration of the testing system; the standard must be analyzed at a frequency of 10 percent or every two hours during the analysis run, whichever is more frequent. The standard also must be analyzed for each analyte at the beginning of the run and after the last analytical sample. the analyte concentration in the CCVS must be at or near the mid-range levels of the calibration curve. The standard may be an EPA CCVS solution, NBS SRM 1643a, or a standard prepared by the laboratory from a certified source.

CONTRACT REQUIRED QUANTITATION LIMIT (CRQL) - Limit of Quantitation (LOQ) - 3 to 10SD. Also used by the EPA CLP.

DATA QUALITY OBJECTIVES (DQOS) - data quality objectives are defined by the U.S. EPA as the expected precision, accuracy, representativeness, completeness, and comparability of an analytical measurement; this is referred to by EPA by the acronym PARCC. However, DQOs also include sample matrix, chemical analytes (parameters) of interest, methods of analysis, detection limits, and holding times. If the laboratory fails to meet the specified DQOs without legitimate explanation, the analysis result may be qualified as either unusable (invalid), or estimated (qualitative use only). Only when all the DQOs have been satisfactorily achieved may the data be considered quantitative.

DECAFLUOROTRIPHENYLPHOSPHINE (DFTPP) - Compound chosen to establish mass spectral tuning performance for semivolatile analysis.

EXTRACTABLE - A compound that can be partitioned into an organic solvent from the sample matrix and is amenable to gas chromatography. Extractables include BNA and pesticide/PCB compounds.

FIELD BLANKS - A field blank is prepared in the field by placing organic free-deionized water in the same type of sample containers as those used for the samples, preserved in the same manner as the samples and analyzed along with the samples for the parameters of interest. Field blanks are collected at a frequency of 1 per 20 samples per matrix. (See Florida Policy in the Sampling Procedures Section for details on the analysis of field blanks).

FIELD REPLICATE - A field replicate is defined as a duplicate sample prepared from equal portions of all aliquots collected for the sample. Both the field replicate and the sample are collected at the same time, in the same type container, preserved the same, and are analyzed by the same laboratory. Field replicates are

collected at the same frequency as field blanks. Field replicates are used to evaluate sampling and analytical precision.

FIELD SPLITS - A field split is defined as a duplicate sample prepared from equal portions of all aliquots collected for the sample. Both the field split and the sample are collected at the same time, in the same type container, preserved the same, but are analyzed by different laboratories employing the exact same method of analysis. Field splits are generally not a required QA parameter; they may be used if there is a potential conflict of interest for the primary laboratory and third party oversight is required to refute potential controversy, or they may be used to evaluate the performance of a particular laboratory (interlaboratory precision). In these cases, the user is cautioned that for accurate comparison, every phase of the testing (sample collection through analysis) must be carefully controlled. Intrinsic differences between laboratories not detectable by routine observations may result in poor comparison of data.

INITIAL CALIBRATION - Analysis of analytical standards for a series of different specified concentrations; used to define the linearity and dynamic range of the response of the mass spectrometer to the target compounds.

ICP INTERFERENCE CHECK SAMPLE ANALYSIS - To verify inter-element and background correction factors, the Contractor must analyze and report the results for an ICP Interference Check sample at the beginning and end of each sample analysis run. The ICP Interference Check Sample must be obtained from EPA (EMSL/LV) if available. Results for the check sample analysis during the analytical runs must fall within the control limit of 20 percent of the true value for the analytes included in the check sample.

ICP SERIAL DILUTION ANALYSIS - Prior to reporting concentration data for the analyte elements, a serial dilution standard should be analyzed. Samples identified as field blanks cannot be used for serial dilution analysis. If the analyte concentration is sufficiently high (a factor of 10 above the IDL) an analysis of 1:4 dilution must agree within 10 percent of the original determination. If the dilution analysis is not within 10 percent, a chemical or physical interference effect should be suspected and the data must be flagged.

IDL - Instrument detection limit (IDL) is the smallest signal above background noise that an instrument can reliably detect.

INITIAL CALIBRATION VERIFICATION STANDARD (ICVS) - Aqueous standard of known concentration prepared from EPA ICVS solution or independent standard (EPA, NBS, or other certified source traceable) at a concentration other than used for calibration; used

to check calibration curve; this standard is used for inorganics analysis by ICP, AA, or Cyanide systems.

INTERNAL STANDARDS - Compounds added to every standard, blank, matrix spike, matrix spike duplicate, sample (for VOAs), and sample extract (for semivolatiles) at a known concentration, prior to analysis. Internal standards are used as the basis for quantitation of the target compounds.

LABORATORY - synonymous with Contractor as used herein.

LABORATORY DUPLICATE - a laboratory duplicate is a duplicate analysis of the submitted sample or sample extract. Laboratory duplicates for extractable samples may be performed by separately extracting and analyzing duplicate aliquots from the same sample or they may be duplicate analyses of the same extract. The purpose of the laboratory duplicate is a measure of the laboratory analytical precision (intralaboratory precision). For soil samples, unless it is important to evaluate the efficiency and precision of the extraction procedure, it is recommended that laboratory duplicates be performed by analyzing a single sample extract in duplicate because of sample inhomogeneity. For water samples, if possible, the duplicate should be performed by separately extracting and analyzing duplicate aliquots from the same sample. Acceptable performance of laboratory duplicates varies between inorganic and organic analyses; for inorganic analyses of analytes in a water matrix, laboratory duplicates should have a relative percent difference (RPD) no greater than 20 percent; for inorganic analyses of analytes in a soil matrix the RPD should not be greater than 35 percent RPD; no standards have been established by CLP for organic analyses of analytes in a water or soil matrix because matrix spikes and matrix spike duplicates are used in lieu of laboratory duplicates.

LDP - laboratory data package; contains laboratory reportables specified by the requested level of reporting.

LINEAR RANGE ANALYSIS - to verify linearity near the detection limit for ICP analysis, the contractor must analyze an ICP standard at two times the detection limit at the beginning and end of each sample analysis run.

LTO - laboratory task order form

LTOA laboratory task order amendment form

MATRIX - the predominant material of which the sample to be analyzed is composed. A sample matrix is either water or soil/sediment. Matrix is <u>not</u> synonymous with phase (liquid or solid).

MATRIX SPIKE - aliquot of a matrix (water or soil) fortified (spiked) with known quantities of specific compounds and subjected to the entire analytical procedure in order to indicate the appropriations of the method for the matrix by measuring recovery.

MATRIX SPIKE DUPLICATE - a second aliquot of the same matrix as the matrix spike (above) that is spiked in order to determine the precision of the method.

MDL - method detection limit (MDL) is the lowest concentration of analyte that a method can detect reliably in either a sample or blank.

METHOD BLANK - (previously termed reagent blank) - an analytical control consisting of all reagents, internal standards and surrogate standards, that is carried through the entire analytical procedure. The method blank is used to define the level of laboratory background contamination.

NARRATIVE (Case Narrative) - portion of the data package which includes laboratory, contract, and sample number identification, and descriptive documentation of any problems encountered in processing the samples, along with corrective action taken and problem resolution.

"ONE BUSINESS DAY" - any day, Monday through Friday, except holidays.

PAC - precision, accuracy, and completeness.

PERCENT MOISTURE - an approximation of the amount of water in a soil/sediment sample made by drying an aliquot of the sample at 105°C. The percent moisture determined in this manner also includes contributions from all compounds that may volatilize at 105°C, including water. Percent moisture is determined from decanted samples and from samples that are not decanted.

PNA - Polynuclear Aromatic Hydrocarbons - Measured by EPA Methods 610 or 625.

PRECISION - A DQO; refers to the ability of the measurement to b reproducible, i.e., to obtain the same result in repeated measurements, statistically may be represented by coefficient of variation (smaller the percent CV the more precise the method), and relative percent difference.

"PRIMARY LABORATORY" - the laboratory to which samples are directly submitted.

PROTOCOL - describes the exact procedures to be followed with respect to sample receipt and handling, analytical methods, data

reporting and deliverables, and document control. Used synonymously with Statement of Work (SOW).

PURGE AND TRAP (DEVICE) - analytical technique (device) used to isolate volatile (purgeable) organics by stripping the compounds from water or soil by a stream of inert gas, trapping the compounds on a porous polymer trap, and thermally desorbing the trapped compounds onto the gas chromatographic column.

QA - Quality Assurance

QC - Quality Control

%r - Percent recovery; a statistical calculation for estimating the accuracy of a method or measurement;
$\%R = \frac{SSR - SR}{SA} \times 100\%$, where SSR equals spiked sample result; SR equals sample result and SA equals amount spiked into sample.

RPD - Relative percent difference; a statistical calculation for estimating the precision of a method or measurement;

$$RPD = \frac{|A - B|}{\frac{A + B}{2}} \times 100$$

where A and B are separate measurements of the same sample or duplicate sample; values less than 20% (inorganics - water matrix) and 30% (organics - water matrix) are considered acceptable.

REAGENT WATER - water in which an interferant is not observed at or above the minimum quantitation limit of the parameters of interest.

RECOVERY - a determination of the accuracy of the analytical procedure made by comparing measured values for a fortified (spiked) sample against the known spike values. Recovery is determined by the following equation:

$$\% \text{ Rec} = \frac{\text{measured value}}{\text{known value}} \times 100\%$$

RELATIVE RESPONSE FACTOR (RRF) - a measure of the relative mass spectral response of an analyte compared to its internal standard. Relative Response Factors are determined by analysis of standards and are used in the calculation of concentrations of analytes in samples. RRF is determined by the following equation:

$$RRF = \frac{A_x}{A_{is}} \times \frac{C_{is}}{C_x}$$

Where A = area of the characteristic ion measured
C = concentration
is = internal standard
x = analyte of interest

RESOLUTION - also termed separation, the separation between peaks on a chromatogram, calculated by dividing the height of the valley between the peaks by the peak height of the smaller peak being resolved, multiplied by 100.

SAMPLE - a portion of material to be analyzed that is contained in single or multiple containers and identified by a unique sample number.

SAMPLE NUMBER - a unique identification number designated for each sample. The sample number appears on the sample report which documents information on that sample.

SAMPLER RINSATE - a sampler rinsate is collected by placing laboratory-grade water in contact with the field sampling apparatus (bailer, pump tubing, etc.) after they have been cleaned and then placing the laboratory grade water in the same type of sample container as the other samples, preserving in the same manner, and analyzed for the parameters of interest. Sampler rinsates are collected at a frequency of 1 per 20 samples per matrix. (See Florida Policy in the Sampling Procedures Section for details on the analysis of sampler rinsates).

"SAMPLE SPECIFIC" - pertains to a procedure (quality assurance or other) being applied to specific samples (in this case Geraghty & Miller samples) within an analysis batch.

SEMIVOLATILE COMPOUNDS - compounds amenable to analysis by extraction of the sample with an organic solvent. Used synonymously with Base/Neutral/Acid (BNA) compounds.

SOIL - used herein synonymously with soil/sediment and sediment.

STANDARD ANALYSIS - an analytical determination made with known quantities of target compounds; used to determine response factors, instrument calibration, and measure precision and accuracy.

SURROGATES (SURROGATE STANDARD) - compounds added to every blank, sample, matrix spike, matrix spike duplicate, and standard; used to evaluate analytical efficiency by measuring recovery. Surrogates are brominated, fluorinated, or isotopically labeled (deuterated) compounds not expected to be detected in environmental media.

SYSTEM PERFORMANCE CHECK COMPOUNDS (SPCC) - target compounds designated to monitor chromatographic performance, sensitivity and

compound instability or degradation on active sites. Minimum response factor criteria for the SPCCs are defined by CLP.

TARGET COMPOUND LIST (TLC) - a list of compounds designated by the Laboratory Contract or Task Order.

TENTATIVELY IDENTIFIED COMPOUNDS (TIC) - compounds detected in samples that are not target compounds, internal standards, or surrogate standards. Up to 30 peaks (those greater than 10 percent of peak areas or heights or nearest internal standards) are subjected to mass spectral library searches for tentative identification.

TRIP BLANK - a trip blank is generally specific to VOC analysis and is required at the frequency of one per sample cooler although in Florida, trip blanks are collected for all parameters of interest. A trip blank is a vial filled with organic-free water in the laboratory that travels unopened with the sample bottles. The trip blank is analyzed along with the samples for the parameters of interest. Trip blanks are submitted at a frequency of 1 per cooler for VOCs but 1 per 20 samples per matrix for all parameters of interest. (See Florida Policy in the Sampling Procedures Section for details on the analysis of trip blanks.)

VALIDATED TIME OF SAMPLE RECEIPT (VTSR) - the date on which a sample is received at the Contractor's facility, as recorded on the shipper's chain-of-custody form.

VOLATILE COMPOUNDS (VOCs) - compounds amenable to analysis by the purge and trap technique. Used synonymously with purgeable compounds.

LEVEL D

Deliverables

LEVEL D

Deliverables

USEPA CONTRACT LABORATORY PROGRAM

STATEMENT OF WORK
FOR
ORGANICS ANALYSIS

Multi-Media, Multi-Concentration

SOW No. 2/88
including Rev. 9/88 and 4/89

EXHIBIT B

REPORTING AND DELIVERABLES REQUIREMENTS

Table of Contents

SECTION I

CONTRACT REPORTS/DELIVERABLES DISTRIBUTION

The following table reiterates the Contract reporting and deliverables requirements specified in the Contract Schedule and specifies the distribution that is required for each deliverable. NOTE: Specific recipient names and addresses are subject to change during the term of the contract. The Project Officer will notify the Contractor in writing of such changes when they occur.

	Item	No. Copies	Delivery Schedule	Distribution (1)	(2)
*A.	Contract Start-Up Plan	2	7 days after contract receipt.	X	X
B.	Updated SOPs	1	120 days after contract receipt.	X	

	Item	No. Copies	Delivery Schedule	Distribution (3)	(4)	(5)	(6)
**C.	Sample Traffic Reports	1	3 days after receipt of last sample in Sample Delivery Group (SDG).****	X			
***D.	Sample Data Summary Package	1	21 days after receipt of last sample in SDG.	X			
***E.	Sample Data Package	3	21 days after receipt of last sample in SDG.	X	X	X	
***F.	Data in Computer-Readable Form	1	21 days after receipt of last sample in SDG.	X			

Distribution:
(1) Project Officer (PO)
(2) Contract Officer (CO)
(3) Sample Management Office (SMO)
(4) EMSL-LV
(5) Region-Client
(6) NEIC

	Item	No. Copies	Delivery Schedule	Distribution (3)	(4)	(5)	(6)
G.	GC/MS Tapes	Lot	Retain for 365 days after data submission, or submit within 7 days after receipt of written request by PO and/or EMSL/LV.	As Directed			
H.	Extracts	Lot	Retain for 365 days after data submission, or submit within 7 days after receipt of written request by PO or SMO.	As Directed			
I.	Complete Case File Purge	1 Pkg	Submit no less than 180 and no more than 240 days after data submission or 7 days after receipt of written request by PO or SMO.				X

* Contractor must be prepared to receive samples within 30 days of contract award. NOTE: EPA can't guarantee <u>exact</u> adherence to start-up plan that is agreed upon by the PO & Contractor, but will attempt to meet it as close as possible.

** Also required in the Sample Data Package.

*** <u>Concurrent</u> delivery required. Delivery shall be made such that all designated recipients receive the item on the same calendar day.

**** Sample Delivery Group (SDG) is a group of samples within a Case, received over a period of 14 days or less and not exceeding 20 samples. Data for all samples in the SDG are due concurrently. (See SOW Exhibit A, paragraph J., for further description).

NOTE: As specified in the Contract Schedule (G.6 Government Furnished Supplies and Materials), unless otherwise instructed by the CLP Sample Management Office, the Contractor shall dispose of unused sample volume and used sample bottles/ containers no earlier than sixty (60) days following submission of analytical data.

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SECTION II

REPORT DESCRIPTIONS AND ORDER OF DATA DELIVERABLES

The Contractor laboratory shall provide reports and other deliverables as specified in the Contract Schedule (Performance/Delivery Schedule, Section F.1). The required content and form of each deliverable is described in this Exhibit.

All reports and documentation MUST BE:

- o Legible,
- o Clearly labeled and completed in accordance with instructions in this Exhibit,
- o Arranged in the order specified in this Section, and
- o Paginated.

If submitted documentation does not conform to the above criteria, the Contractor will be required to resubmit such documentation with deficiency(ies) corrected, at no additional cost to the Agency.

Whenever the Contractor is required to submit or resubmit data as a result of an on-site laboratory evaluation or through a PO/DPO action, the data must be clearly marked as ADDITIONAL DATA and must be sent to all three contractual data recipients (SMO, EMSL-LV, and Region). A cover letter shall be included which describes what data is being delivered, to which EPA Case(s) it pertains, and <u>who requested the data</u>.

Whenever the Contractor is required to submit or resubmit data as a result of Contract Compliance Screening (CCS) review by SMO, the data must be sent to all three contractual data recipients (SMO, EMSL/LV and Region), and in all three instances must be accompanied by a color-coded COVER SHEET (Laboratory Response To Results of Contract Compliance Screening) provided by SMO.

Section III of this Exhibit contains copies of the required data reporting forms in Agency-specified formats, along with instructions to assist the Contractor in accurately providing the Agency all required data. Data elements with field parameters for reporting data in computer readable form are contained in Exhibit H.

Descriptions of the requirements for each deliverable item cited in the Contract Performance/Delivery Schedule (Contract Schedule, Section F.1) are specified in parts A-G of this Section. Items submitted concurrently MUST BE arranged in the order listed. Additionally, the components of each item MUST BE arranged in the order presented in this Section when the item is submitted.

Examples of specific data deliverables not included herein may be obtained by submitting a written request to the EPA Project Officer, stating the information requested, and signed by the Laboratory Manager.

A. Contract Start-Up Plan

The Contractor shall submit a contract start-up plan for EPA approval as specified in the Contract Performance/Delivery Schedule. The plan shall set forth the Contractor's proposed schedule for receiving samples starting with the 30th calendar day after award and ending with the date the Contractor is capable of receiving the full monthly sample allotment stipulated in the Contract. The Project Officer will review the contract start-up plan within 7 days of submission and will notify the Contractor of the plan's status.

NOTE: The Contractor shall be required to receive samples within 30 days of contract award. EPA can't guarantee exact adherence to start-up plan that is agreed upon by the PO and Contractor, but will attempt to meet it as close as possible.

B. Updated SOPs

The Contractor shall submit updated copies of all required Standard Operating Procedures (SOPs) that were submitted with the prebid Performance Evaluation sample results. The updated SOPs must address any and all issues of laboratory performance and operation identified through the review of the Performanc Evaluation sample data and the evaluation of Bidder-Supplied Documentation.

The Contractor must supply SOPs for:

1. Sample receipt and logging.
2. Sample and extract storage.
3. Preventing sample contamination.
4. Security for laboratory and samples.
5. Traceability/Equivalency of standards.
6. Maintaining instrument records and logbooks.
7. Sample analysis and data control systems.
8. Glassware cleaning.
9. Technical and managerial review of laboratory operation and data package preparation.
10. Internal review of contractually-required quality assurance and quality control data for each individual data package.
11. Sample analysis, data handling and reporting.
12. Chain-of-custody.
13. Document control, including case file preparation.

Note: Such documentation is not required to conform specifically (i.e., in every detail) to this contract's requirements, but shall be representative of standard laboratory operations, and shall give clear evidence of the Contractor's ability to successfully fulfill all contract requirements.

C. Sample Traffic Reports

Original Sample Traffic Report page marked "Lab Copy for Return to SMO" with lab receipt information and signed in original Contractor signature, for each sample in the Sample Delivery Group.

Traffic Reports (TRs) shall be submitted in Sample Delivery Group (SDG) sets (i.e., TRs for all samples in an SDG shall be clipped together), with an SDG Cover Sheet attached.

The SDG Cover Sheet shall contain the following items:

- Lab name
- Contract number
- Sample Analysis Price - full sample price from contract.
- Case Number
- List of EPA sample numbers of all samples in the SDG, identifying the first and last samples received, and their dates of receipt (TRDs). NOTE: When more than one sample is received in the first or last SDG shipment, the "first" sample received would be the lowest sample number (considering both alpha and numeric designations); the "last" sample received would be the highest sample number (considering both alpha and numeric designations).

In addition, each Traffic Report must be clearly marked with the SDG Number, the sample number of the first sample in the SDG (as described in the following paragraph). This information should be entered below the Lab Receipt Date on the TR. In addition, the TR for the last sample received in the SDG must be clearly marked "SDG - FINAL SAMPLE."

The EPA sample number of the first sample received in the SDG is the SDG number. When several samples are received together in the first SDG shipment, the SDG number shall be the lowest sample number (considering both alpha and numeric designations) in the first group of samples received under the SDG. (The SDG number is also reported on all data reporting forms. See Section III, Forms Instruction Guide.)

If samples are received at the laboratory with multi-sample Traffic Reports (TRs), all the samples on one multi-sample TR may not necessarily be in the same SDG. In this instance, the laboratory must make the appropriate number of photocopies of the TR, and submit one copy with each SDG cover sheet.

D. Sample Data Summary Package

As specified in the Delivery Schedule, one Sample Data Summary Package shall be delivered to SMO concurrently with delivery of other required sample data. The Sample Data Summary Package consists of copies of specified items from the Sample Data Package. These items are listed below and described under part E, Sample Data Package.

The Sample Data Summary Package shall be ordered as follows and shall be submitted separately (i.e., separated by rubber bands, clips or other means) directly preceding the Sample Data Package. Sample data forms shall be arranged in increasing EPA sample number order, considering both letters and numbers. BE400 is a lower sample number than BF100, as E precedes F in the alphabet.

The Sample Data Summary Package shall contain data for samples in one Sample Delivery Group of the Case, as follows:

1. Case Narrative

2. By fraction (VOA, SV, PEST) and by sample within each fraction - tabulated target compound results (Form I) and tentatively identified compounds (Form I, TIC)(VOA and SV only)

3. By fraction (VOA, SV, PEST) - surrogate spike analysis results (Form II) by matrix (water and/or soil) and for soil, by concentration (low or medium)

4. By fraction (VOA, SV, PEST) - matrix spike/matrix spike duplicate results (Form III)

5. By fraction (VOA, SV, PEST) - blank data (Form IV) and tabulated results (Form I) including tentatively identified compounds (Form I TIC)(VOA and SV only).

6. By fraction (VOA, SV only) - internal standard area data (Form VIII).

E. Sample Data Package

The Sample Data Package is divided into the five major units described below. The last three units are each specific to an analytical fraction (volatiles, semivolatiles, pesticides/PCBs). If the analysis of a fraction is not required, then that fraction-specific unit is not required as a deliverable.

The Sample Data Package shall include data for analyses of all samples in one Sample Delivery Group, including field samples, reanalyses, blanks, matrix spikes, and matrix spike duplicates.

1. Case Narrative

This document shall be clearly labeled "Case Narrative" and shall contain: laboratory name; Case number; sample numbers in the Sample Delivery Group (SDG), differentiating between initial analyses and re-analyses; SDG number; Contract number; and detailed documentation of any quality control, sample, shipment and/or analytical problems encountered in processing the samples reported in the data package.

Whenever data from sample re-analyses are submitted, the Contractor shall state in the Case Narrative for each re-analysis, whether it considers the re-analysis to be billable, and if so, why.

The Contractor must also include any problems encountered; both technical and administrative, the corrective actions taken, and resolution.

The Case Narrative shall contain the following statement, verbatim: "I certify that this data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hardcopy data package and in the computer-readable data submitted on floppy diskette has been authorized by the Laboratory Manager or his designee, as verified by the following signature." This statement shall be directly followed by signature of the Laboratory Manager or his designee with a typed line below it containing the signer's name and title, and the date of signature.

Additionally, the Case Narrative itself must be signed in original signature by the Laboratory Manager or his designee and dated.

2. Traffic Reports

A copy of the Sample Traffic Reports submitted in Item A for all of the samples in the SDG. The Traffic Reports shall be arranged in increasing EPA sample number order, considering both letters and numbering in ordering samples. Copies of the SDG cover sheet is to be included with the copies of the Traffic Reports.

If samples are received at the laboratory with multi-sample Traffic Reports (TRs), all the samples on one multi-sample TR may not necessarily be in the same SDG. In this instance, the laboratory must make the appropriate number of photocopies of the TR so that a copy is submitted with each data package to which it applies. In addition, in any instance where samples from more than one multi-sample TR are in the same data package, the laboratory must submit a copy of the SDG cover sheet with copies of the TRs.

3. Volatiles Data

a. QC Summary

(1) Surrogate Percent Recovery Summary (Form II VOA)

(2) Matrix Spike/Matrix Spike Duplicate Summary (Form III VOA)

(3) Method Blank Summary (Form IV VOA)

(If more than a single form is necessary, forms must be arranged in chronological order by date of analysis of the blank.)

(4) GC/MS Tuning and Mass Calibration (Form V VOA)

BFB in chronological order; by instrument.

(5) Internal Standard Area Summary (Form VIII VOA)

In chronological order; by instrument.

b. Sample Data

Sample data shall be arranged in packets with the Organic Analysis Data Sheet (Form I VOA, including Form I VOA-TIC), followed by the raw data for volatile samples. These sample packets should then be placed in increasing EPA sample number order, considering both letters and numbers in ordering samples.

(1) TCL Results - Organic Analysis Data Sheet (Form I VOA).

Tabulated results (identification and quantitation) of the specified target compounds (Exhibit C). The validation and release of these results is authorized by a specific, signed statement in the Case Narrative (reference C.1). In the event that the Laboratory Manager cannot validate all data reported for each sample, the Laboratory Manager shall provide a detailed description of the problems associated with the sample in the Case Narrative.

On Form I, the appropriate concentration units shall be entered. For example, ug/L for water samples or ug/Kg for soil/sediment samples. No other units are acceptable. NOTE: Report analytical results to one significant figure if the value is less than 10; to two significant figures above 10.

(2) Tentatively Identified Compounds (Form I VOA-TIC).

This form must be included even if no compounds are found. If so, indicate this on the form by entering "0" in the field for "Number found."

Form I VOA-TIC is the tabulated list of the highest probable match for up to 10 of the nonsurrogate organic compounds not listed in Exhibit C (TCL), including the CAS (Chemical Abstracts Registry) number, tentative identification and estimated concentration. For estimating concentration, assume a response factor of 1, and estimate the concentration by comparison of the compound peak height or total area count to the peak height or total area count of the nearest internal standard free of interferences on the reconstructed ion chromatogram. NOTE: The laboratory must be consistent (i.e., use peak height for all comparisons or use total area count for all comparisons).

(3) Reconstructed total ion chromatograms (RIC) for each sample or sample extract.

RICs must be normalized to the largest nonsolvent component, and must contain the following header information:

- o EPA sample number
- o Date and time of analysis
- o GC/MS instrument ID
- o Lab file ID

Internal standard and surrogate spiking compounds are to be labeled with the names of compounds, either directly out from the peak, or on a print-out of retention times if retention times are printed over the peak. If automated data system procedures are used for preliminary identification and/or quantification of the Target Compound List (TCL) compounds, the complete data system report must be included in all sample data packages, in addition to the reconstructed ion chromatogram. The complete data system report shall include all of the information listed below. For laboratories which do not use the automated data system procedures, a laboratory "raw data sheet," containing the following information, must be included in the sample data package in addition to the chromatogram.

- o EPA sample number
- o Date and time of analysis
- o RT or scan number of identified TCL compounds
- o Ion used for quantitation with measured area
- o Copy of area table from data system
- o GC/MS instrument ID
- o Lab file ID

(4) For each sample, by each compound identified:

(a) Copies of raw spectra and copies of background-subtracted mass spectra of target compounds listed in Exhibit C (TCL) that are identified in the sample and corresponding background-subtracted TCL standard mass spectra. Spectra must be labeled with EPA sample number, lab file ID, date and time of analysis, and GC/MS instrument ID; compound names must be clearly marked on all spectra.

(b) Copies of mass spectra of nonsurrogate organic compounds not listed in Exhibit C (TCL) (Tentatively Identified Compounds) with associated best-match spectra (three best matches), labeled as in (4)(a) above.

c. Standards Data

(1) Initial Calibration Data (Form VI VOA) - in order by instrument, if more than one instrument used.

(a) VOA standard(s) reconstructed ion chromatograms and quantitation reports (or legible facsimile) for the initial (five point) calibration, labeled as in b.(3) above. Spectra are not required.

(b) All initial calibration data must be included, regardless of when it was performed and for which case. When more than one initial calibration is performed, the data must be put in chronological order, by instrument.

(2) Continuing Calibration (Form VII VOA) - in order by instrument, if more than one instrument used.

(a) VOA standard(s) reconstructed ion chromatograms and quantitation reports (or legible facsimile) for all continuing (12 hour) calibrations, labeled as in b.(3) above. Spectra are not required.

(b) When more than one continuing calibration is performed, forms must be in chronological order, within fraction and instrument.

(3) Internal Standard Area Summary (Form VIII VOA) - in order by instrument, if more than one instrument used.

When more than one continuing calibration is performed, forms must be in chronological order, by instrument.

d. Raw QC Data

(1) BFB (for each 12-hour period, for each GC/MS system utilized)

(a) Bar graph spectrum, labeled as in b.(3) above.

(b) Mass listing, labeled as in b.(3) above.

(2) Blank Data - in chronological order. NOTE: This order is different from that used for samples.

(a) Tabulated results (Form I VOA)

(b) Tentatively Identified Compounds (Form I VOA-TIC) even if none found.

(c) Reconstructed ion chromatogram(s) and quantitation report(s) or legible facsimile (GC/MS), labeled as b.(3) above.

(d) TCL spectra with lab generated standard, labeled as in b.(4) above. Data systems which are incapable of dual display shall provide spectra in order:

- o Raw TCL compound spectra
- o Enhanced or background subtracted spectra
- o Laboratory generated TCL standard spectra

(e) GC/MS library search spectra for Tentatively Identified Compounds (TIC), labeled as in b.(4) above.

(f) Quantitation/Calculation of Tentatively Identified Compound(s) (TIC) concentrations

(3) Matrix Spike Data

(a) Tabulated results (Form I VOA) of nonspiked TCL compounds. Form I VOA-TIC not required.

(b) Reconstructed ion chromatogram(s) and quantitation report(s) or legible facsimile (GC/MS), labeled as in b.(4) above. Spectra not required.

(4) Matrix Spike Duplicate Data

(a) Tabulated results (Form I VOA) of nonspiked TCL compounds. Form I VOA-TIC not required.

(b) Reconstructed ion chromatogram(s) and quantitation report(s) or legible facsimile (GC/MS), labeled as in b.(4) above. Spectra not required.

4. Semivolatiles Data

a. QC Summary

(1) Surrogate Percent Recovery Summary (Form II SV)

(2) Matrix Spike/Matrix Spike Duplicate Summary (Form III SV)

(3) Method Blank Summary (Form IV SV)

(If more than a single form is necessary, forms must be arranged in chronological order by date of analysis of the blank.)

(4) GC/MS Tuning and Mass Calibration (Form V SV)

DFTPP in chronological order; by instrument.

(5) Internal Standard Area Summary (Form VIII SV)

In chronological order; by instrument.

b. Sample Data

Sample data shall be arranged in packets with the Organic Analysis Data Sheet (Form I SV, including Form I SV-TIC), followed by the raw data for semivolatile samples. These sample packets should then be placed in increasing EPA sample number order, considering both letters and numbers in ordering samples.

(1) TCL Results - Organic Analysis Data Sheet (Form I SV-1, SV-2).

Tabulated results (identification and quantitation) of the specified target compounds (Exhibit C). The validation and release of these results is authorized by a specific, signed statement in the Case Narrative (reference E.1). In the event that the Laboratory Manager cannot validate all data reported for each sample, the Laboratory Manager shall provide a detailed description of the problems associated with the sample in the Case Narrative.

On Form I, the appropriate concentration units shall be entered. For example, ug/L for water samples or ug/Kg for soil/sediment samples. No other units are acceptable. NOTE: Report analytical results to one significant figure if the value is less than 10; to two significant figures above 10.

(2) Tentatively Identified Compounds (Form I SV-TIC).

This form must be included even if no compounds are found. If so, indicate this on the form by entering "0" in the field for "Number found".

Form I SV-TIC is the tabulated list of the highest probable match for up to 20 of the nonsurrogate organic compounds not listed in Exhibit C (TCL), including the CAS (Chemical Abstracts Registry) number, tentative identification and estimated concentration. For estimating concentration, assume a response factor of 1, and estimate the concentration by comparison of the compound peak height or total area count to the peak height or total area count of the nearest internal standard free of interferences on the reconstructed ion chromatogram. NOTE: The laboratory must be consistent (i.e., use peak height for all comparisons or use total area count for all comparisons).

(3) Reconstructed total ion chromatograms (RIC) for each sample, sample extract, standard, blank, and spiked sample.

RICs must be normalized to the largest nonsolvent component, and must contain the following header information:

- o EPA sample number
- o Date and time of analysis
- o GC/MS instrument ID
- o Lab file ID

Internal standard and surrogate spiking compounds are to be labeled with the names of compounds, either directly out from the peak, or on a print-out of retention times if retention times are printed over the peak. If automated data system procedures are used for preliminary identification and/or quantification of the Target Compound List (TCL) compounds, the complete data system report must be included in all sample data packages, in addition to the reconstructed ion chromatogram. The complete data system report shall include all of the information listed below. For laboratories which do not use the automated data system procedures, a laboratory "raw data sheet," containing the following information, must be included in the sample data package in addition to the chromatogram.

- o EPA sample number
- o Date and time of analysis
- o RT or scan number of identified TCL compounds
- o Ion used for quantitation with measured area
- o Copy of area table from data system
- o GC/MS instrument ID
- o Lab file ID

(4) For each sample, by each compound identified:

(a) Copies of raw spectra and copies of background-subtracted mass spectra of target compounds listed in Exhibit C (TCL) that are identified in the sample and corresponding background-subtracted TCL standard mass spectra. Spectra must be labeled with EPA sample number, lab file ID, date and time of analysis, and GC/MS instrument ID; compound names must be clearly marked on all spectra.

(b) Copies of mass spectra of nonsurrogate organic compounds not listed in Exhibit C (TCL) (Tentatively Identified Compounds) with associated best-match spectra (three best matches), labeled as in (4)(a) above.

(c) GPC chromatograms (if GPC performed).

c. Standards Data

(1) Initial Calibration Data (Form VI SV-1, SV-2) - in order by instrument, if more than one instrument used.

(a) BNA standard(s) reconstructed ion chromatograms and quantitation reports (or legible facsimile) for the initial (five point) calibration, labeled as in b.(3) above. Spectra are not required.

(b) All initial calibration data must be included, regardless of when it was performed and for which case. When more than one initial calibration is performed, the data must be put in chronological order, by instrument.

(2) Continuing Calibration (Form VII SV-1, SV-2) - in order by instrument, if more than one instrument used.

(a) BNA standard(s) reconstructed ion chromatograms and quantitation reports (or legible facsimile) for all continuing (12 hour) calibrations, labeled as in b.(3) above. Spectra are not required.

(b) When more than one continuing calibration is performed, forms must be in chronological order, by instrument.

(3) Internal Standard Area Summary (Form VIII SV-1, SV-2) - in order by instrument, if more than one instrument used.

When more than one continuing calibration is performed, forms must be in chronological order by instrument.

d. Raw QC Data

(1) DFTPP (for each 12-hour period, for each GC/MS system utilized)

(a) Bar graph spectrum, labeled as in b.(3) above.

(b) Mass listing, labeled as in b.(3) above.

(2) Blank Data - in chronological order. NOTE: This order is different from that used for samples.

(a) Tabulated results (Form I SV-1, SV-2)

(b) Tentatively Identified Compounds (Form I SV-TIC) - even if none found.

(c) Reconstructed ion chromatogram(s) and quantitation report(s) or legible facsimile (GC/MS), labeled as in b.(3) above.

(d) TCL spectra with lab generated standard, labeled as in b.(4) above. Data systems which are incapable of dual display shall provide spectra in order:

- o Raw TCL compound spectra
- o Enhanced or background subtracted spectra
- o Laboratory generated TCL standard spectra

(e) GC/MS library search spectra for Tentatively Identified Compounds (TIC), labeled as in b.(4) above.

(f) Quantitation/Calculation of Tentatively Identified Compound(s) (TIC) concentrations

(3) Matrix Spike Data

(a) Tabulated results (Form I) of nonspiked TCL compounds. Form 1 SV-TIC not required.

(b) Reconstructed ion chromatogram(s) and quantitation report(s) or legible facsimile (GC/MS), labeled as in b.(3) above. Spectra not required.

(4) Matrix Spike Duplicate Data

(a) Tabulated results (Form I SV-1, SV-2) of nonspiked TCL compounds. Form 1 SV-TIC not required.

(b) Reconstructed ion chromatogram(s) and quantitation report(s) or legible facsimile (GC/MS), labeled as in b.(3) above. Spectra not required.

5. Pesticide/PCB Data

a. QC Summary

(1) Surrogate Percent Recovery Summary (Form II PEST)

(2) Matrix Spike/Matrix Spike Duplicate Summary (Form III PEST)

(3) Method Blank Summary (Form IV PEST)

(If more than a single form is necessary, forms must be arranged in chronological order by date of analysis of the blank.)

b. Sample Data

Sample data shall be arranged in packets with the Organic Analysis Data Sheet (Form I PEST), followed by the raw data for pesticide samples. These sample packets should then be placed in increasing EPA sample number order, considering both letters and numbers in ordering samples.

(1) TCL Results - Organic Analysis Data Sheet (Form I PEST).

Tabulated results (identification and quantitation) of the specified target compounds (Exhibit C). The validation and release of these results is authorized by a specific, signed statement in the Case Narrative (reference E.1). In the event that the Laboratory Manager cannot validate all data reported for each sample, the Laboratory Manager shall provide a detailed description of the problems associated with the sample in the Case Narrative.

On Form I PEST, the appropriate concentration units shall be entered. For example, ug/L for water samples or ug/Kg for soil/sediment samples. No other units are acceptable.

NOTE: Report analytical results to two significant figures for all pesticide/PCB samples.

(2) Copies of pesticide chromatograms.

All chromatograms must be labeled with the following information:

- o EPA sample number
- o Volume injected (ul)
- o Date and time of injection
- o GC column identification (by stationary phase)
- o GC instrument identification
- o Positively identified compounds must be labeled with the names of compounds, either directly out from the peak, or on a print-out of retention times if retention times are printed over the peak.

(3) Copies of pesticide chromatograms from second GC column confirmation. Chromatograms to be labeled as in (2) above.

(4) GC Integration report or data system printout and calibration plots (area vs. concentration) for 4,4'-DDT, 4,4'-DDD, 4,4'-DDE or toxaphene (where appropriate).

(5) Manual work sheets.

(6) UV traces from GPC (if available).

(7) If pesticide/PCBs are confirmed by GC/MS, the Contractor shall submit copies of raw spectra and copies of background-subtracted mass spectra of target compounds listed in Exhibit C (TCL) that are identified in the sample and corresponding background-subtracted TCL standard mass spectra. Compound names must be clearly marked on all spectra. For multicomponent pesticides/PCBs confirmed by GC/MS, the Contractor shall submit mass spectra of 3 major peaks of multicomponent compounds from samples and standards.

c. Standards Data

(1) Form VIII PEST - Pesticide Evaluation Standards Summary (all GC columns)

(2) Form IX PEST - Pesticide/PCB Standards Summary (all GC columns)

(3) Form X PEST - Pesticide/PCB Identification (only required for positive results)

(4) Pesticide standard chromatograms and data system printouts for <u>all</u> standards to include:

- o Evaluation Standard Mix A
- o Evaluation Standard Mix B
- o Evaluation Standard Mix C
- o Individual Standard Mix A
- o Individual Standard Mix B
- o All multiresponse pesticides/PCBs
- o All quantitation standards
- o A copy of the computer reproduction or strip chart recorder output covering the 100 fold range

(a) All chromatograms are required to have the following:

- o Label all chromatograms with the "EPA Sample Number" for standards, i.e. EVALA, EVALB, etc. (See Forms Instructions for details).

- Label all standard peaks for all individual compounds either directly out from the peak or on the printout of retention times if retention times are printed over the peak.
- List total ng injected for each standard.
- A printout of retention times and corresponding peak areas must accompany each chromatogram.
- Date and time of injection.
- GC column identification (by stationary phase).
- GC instrument identification.

d. Raw QC Data

(1) Blank Data - in chronological order. NOTE: This order is different from that used for samples.

(a) Tabulated results (Form I PEST).

(b) Chromatogram(s) and data system printout(s) (GC) for each GC column and instrument used for analysis, labeled as in b.(2) above.

(2) Matrix Spike Data

(a) Tabulated results (Form I PEST) of nonspike TCL compounds.

(b) Chromatogram(s) and data system printout(s) (GC), labeled as in b.(2) above.

(3) Matrix Spike Duplicate Data

(a) Tabulated results (Form I PEST) of nonspike TCL compounds.

(b) Chromatogram(s) and data system printout(s) (GC), labeled as in b.(2) above.

F. Data in Computer-Readable Form

The Contractor shall provide a computer-readable copy of the data on data reporting Forms I-X for all samples in the Sample Delivery Group, as specified in the Contract Performance/Delivery Schedule. Computer-readable data deliverables shall be submitted on IBM or IBM-compatible, 5.25 inch floppy double-sided, double density 360 K-byte or a high density 1.2 M-byte diskette.

When submitted, floppy diskettes shall be packaged and shipped in such a manner that the diskette(s) cannot be bent or folded, and will not be exposed to extreme heat or cold or any type of electromagnetic radiation. The diskette(s) must be included in the same shipment as the hardcopy data and shall, at a minimum, be enclosed in a diskette mailer

The data shall be recorded in ASCII, text file format, and shall adhere to the file, record and field specifications listed in Exhibit H, Data Dictionary and Format for Data Deliverables in Computer-Readable Format.

If the Contractor wishes to use a reporting format other than the one specified, equivalence must be demonstrated and approved by the Project Officer prior to the award of the contract.

G. GC/MS Tapes

The Contractor must store all raw and processed GC/MS data on magnetic tape, in appropriate instrument manufacturer's format. This tape must include data for samples, blanks, matrix spikes, matrix spike duplicates, initial calibrations, continuing calibrations, BFB and DFTPP, as well as all laboratory-generated spectral libraries and quantitation reports required to generate the data package. The Contractor shall maintain a written reference logbook of tape files to EPA sample number, calibration data, standards, blanks, matrix spikes, and matrix spike duplicates. The logbook should include EPA sample numbers and standard and blank ID's, identified by Case and Sample Delivery Group.

The Contractor is required to retain the GC/MS tapes for 365 days after data submission. During that time, the Contractor shall submit tapes and associated logbook pages within seven days after receipt of a written request from the Project Officer.

H. Extracts

The Contractor shall preserve sample extracts at 4°C (±2°C) in bottles/vials with Teflon-lined septa. Extract bottles/vials shall be labeled with EPA sample number, Case number and Sample Delivery Group (SDG) number. A logbook of stored extracts shall be maintained, listing EPA sample numbers and associated Case and SDG numbers.

The Contractor is required to retain extracts for 365 days following data submission. During that time, the Contractor shall submit extracts and associated logbook pages within seven days following receipt of a written request from the Project Officer or the Sample Management Office.

I. Complete Case File Purge

(Formerly, Document Control and Chain-of-Custody Package).

The complete case file purge includes all laboratory records received or generated for a specific Case that have not been previously submitted to EPA as a deliverable. These items include but are not limited to: sample tags, custody records, sample tracking records, analysts logbook pages, bench sheets, chromatographic charts, computer printouts, raw data summaries, instrument logbook pages, correspondence, and the document inventory (see Exhibit F).

USEPA CONTRACT LABORATORY PROGRAM

STATEMENT OF WORK
FOR
INORGANICS ANALYSIS

Multi-Media

Multi-Concentration

SOW No. 788
including Rev. 2/89 and 6/89

EXHIBIT B

REPORTING AND DELIVERABLES REQUIREMENTS

SECTION I

CONTRACT REPORTS/DELIVERABLES DISTRIBUTION

The following table reiterates the Contract reporting and deliverables requirements specified in the Contract Schedule and specifies the distribution that is required each deliverable. NOTE: Specific recipient names and addresses are subject to change during the term of the contract. The Project Officer will notify the Contractor in writing of such changes when they occur.

	Item	Copies	Schedule	Distribution (1)	(2)	(4)
*A.	Contract Start-Up Plan	2	7 days after contract receipt.	X	X	
B.	Updated SOPs	1	120 days after contract receipt.	X		X

	Item	No. Copies	Delivery Schedule	Distribution (3)	(4)	(5)	(6)
**C.	Sample Traffic Reports	1	3 days after receipt of last sample in Sample Delivery Group (SDG)****	X			
***D.	Sample Data Package	3	35 days after receipt of last sample in SDG	X	X	X	
***E.	Data in Computer-Readable Form	1	35 days after receipt of last sample in SDG	X			
F.	Results of Inter-comparison Study/ PE Sample Analysis	2	35 days after receipt of last sample in SDG	X	X		
G.	Compilation of Complete Case File Purge	1	7 days after data submission	--	N/A	--	
H.	Complete Case File Purge	1	180 days after data submission or 7 days from receipt of written request by PO or SMO				X

Pages B-2 and B-3 of the EPA Document
are not pertinent to these deliverables.

REPORT DESCRIPTIONS AND ORDER OF DATA DELIVERABLES

The Contractor laboratory shall provide reports and other deliverables as specified in the Contract Performance/Delivery Schedule (see Contract Schedule, Section F). The required content and form of each deliverable is described in this Exhibit.

All reports and documentation MUST BE:

- Legible,
- Clearly labeled and completed in accordance with instructions in this Exhibit,
- Arranged in the order specified in this Section,
- Paginated, and
- Single-sided.

If submitted documentation does not conform to the above criteria, the Contractor will be required to resubmit such documentation with deficiency(ies) corrected, at no additional cost to the government.

Whenever the Contractor is required to submit or resubmit data as a result of an on-site laboratory evaluation or through a PO/DPO action, the data must be clearly marked as ADDITIONAL DATA and must be sent to all three contractual data recipients (SMO, EMSL-LV, and Region). A cover letter shall be included which describes what data is being delivered, to which EPA Case(s) the data pertains, and who requested the data.

Whenever the Contractor is required to submit or resubmit data as a result of Contract Compliance Screening (CCS) review by SMO, the data must be sent to all three contractual data recipients (SMO, EMSL/LV and Region), and in all three instances must be accompanied by a color-coded COVER SHEET (Laboratory Response To Results of Contract Compliance Screening) provided by SMO. Diskette deliverables need only be submitted or resubmitted to SMO.

Section IV of this Exhibit contains the required Inorganic Analysis Data Reporting Forms in Agency-specified formats; Section III of this Exhibit contains instructions to the Contractor for properly completing all data reporting forms to provide the Agency with all required data. Data elements and field descriptors for reporting data in computer-readable format are contained in Exhibit H.

Descriptions of the requirements for each deliverable item cited in the Contract Performance/Delivery Schedule (see Contract Schedule, Section F) are specified in parts A-G of this Section. Items submitted concurrently must be arranged in the order listed. Additionally, the components of each item must be arranged in the order presented herein when the item is submitted.

The Contractor shall submit a contract start-up plan for EPA approval as specified in the Contract Performance/Delivery Schedule. The plan shall set forth the Contractor's proposed schedule for receiving samples starting with the 30th calendar day after award and ending with the date the Contractor is capable of receiving the full monthly sample allotment stipulated in the Contract. The Project Officer will review the contract start-up plan within 7 days of submission and will notify the Contractor of the plan's status.

NOTE: The Contractor shall be required to receive samples within 30 days of contract award. EPA can't guarantee exact adherence to start-up plan that is agreed upon by the PO and Contractor, but will attempt to meet it as close as possible.

B. Updated SOPs

The Contractor shall submit updated copies of all required Standard Operating Procedures (SOPs) that were submitted with the prebid Performance Evaluation sample results. The updated SOPs must address any and all issues of laboratory performance and operation identified through the review of the Performanc Evaluation sample data and the evaluation of Bidder-Supplied Documentation.

The Contractor must supply SOPs for:

1. Sample receipt and logging.
2. Sample and extract storage.
3. Preventing sample contamination.
4. Security for laboratory and samples.
5. Traceability/Equivalency of standards.
6. Maintaining instrument records and logbooks.
7. Sample analysis and data control systems.
8. Glassware cleaning.
9. Technical and managerial review of laboratory operation and data package preparation.
10. Internal review of contractually-required quality assurance and quality control data for each individual data package.
11. Sample analysis, data handling and reporting.
12. Chain-of-custody.
13. Document control, including case file preparation.

Original Sample Traffic Report page marked "Lab Copy for Return to SMO" with lab receipt information and signed in original Contractor signature, shall be submitted for each sample in the Sample Delivery Group.

Traffic Reports (TRs) shall be submitted in Sample Delivery Group (SDG) sets (i.e., TRs for all samples in an SDG shall be clipped together), with an SDG Cover Sheet attached.

The SDG Cover Sheet shall contain the following items:

- o Lab name
- o Contract number
- o Sample Analysis Price - full sample price from contract.
- o Case Number
- o List of EPA sample numbers of all samples in the SDG, identifying the first and last samples received, and their dates of receipt.

NOTE: When more than one sample is received in the first or last SDG shipment, the "first" sample received would be the lowest sample number (considering both alpha and numeric designations); the "last" sample received would be the highest sample number (considering both alpha and numeric designations).

In addition, each Traffic Report must be clearly marked with the SDG Number, the sample number of the first sample in the SDG (as described in the following paragraph). This information should be entered below the Lab Receipt Date on the TR.

The EPA sample number of the first sample received in the SDG is the SDG number. When several samples are received together in the first SDG shipment, the SDG number shall be the lowest sample number (considering both alpha and numeric designations) in the first group of samples received under the SDG. (The SDG number is also reported on all data reporting forms. See Section III, Form Instruction Guide.)

If samples are received at the laboratory with multi-sample Traffic Reports (TRs), all the samples on one multi-sample TR may not necessarily be in the same SDG. In this instance, the laboratory must make the appropriate number of photocopies of the TR, and submit one copy with each SDG cover sheet.

D. Sample Data Package

The sample data package shall include data for analysis of all samples in one Sample Delivery Group (SDG), including analytical (field) samples, reanalyses, blanks, spikes, duplicates, and laboratory control samples.

The sample data package must be complete before submission, must be consecutively paginated (starting with page number one and ending with the number of all pages in the package), and shall include the following:

1. Cover Page for the Inorganic Analyses Data Package, (COVER PAGE -- Inorganic Analyses Data Package), including: laboratory name; laboratory code; contract number; Case No.; Sample Delivery Group (SDG) No.; Statement of Work (SOW) number (appears on cover page of SOW); EPA sample numbers in alphanumeric order, showing EPA sample numbers cross-referenced with lab ID numbers; comments, describing in detail any problems encountered in processing the samples in the data package; and, completion of the statement on use of ICP background and interelement corrections for the samples.

   The Cover Page shall contain the following statement, verbatim: "I certify that this data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hardcopy data package and in the computer-readable data submitted on floppy diskette has been authorized by the Laboratory Manager or the Manager's designee, as verified by the following signature." This statement shall be directly followed by the signature of the Laboratory Manager or his designee with a typed line below it containing the signers name and title, and the date of signature.

   In addition, on a separate piece of paper, the Contractor must also include any problems encountered; both technical and administrative, the corrective action taken and resolution.

2. Sample Data

   Sample data shall be submitted with the Inorganic Analysis Data Reporting Forms for all samples in the SDG, arranged in increasing alphanumeric EPA sample number order, followed by the QC analyses data, Quarterly Verification of Instrument Parameters forms, raw data, and copies of the digestion and distillation logs.

   a. Results -- Inorganic Analysis Data Sheet [FORM I - IN]

      Tabulated analytical results (identification and quantitation) of the specified analytes (Exhibit C). The validation and release of these results is authorized by a specific, signed statement on the Cover Page. If the Laboratory Manager cannot validate all data reported for each sample, he/she must provide a detailed description of the problems associated with the sample(s) on the Cover Page.

      Appropriate concentration units must be specified and entered on Form I. The quantitative values shall be reported in units of micrograms per liter (ug/L) for aqueous samples and milligrams per kilogram (mg/kg) for solid samples. No other units are acceptable. Results for solid samples must be reported on a dry weight basis. Analytical results must be reported to two significant figures if the result value is less than 10; to three significant figures if the value is greater than or equal to 10. Results for percent solids must be reported to one decimal place. The preceding discussion concerning significant numbers applies to Form I only. For

other Forms, follow the instructions specific to those forms as contained in this exhibit.

b. Quality Control Data

1) Initial and Continuing Calibration Verification [FORM II (PART 1) - IN]

2) CRDL Standard for AA and Linear Range Analysis for ICP [FORM II (PART 2) - IN]

3) Blanks [FORM III - IN]

4) ICP Interference Check Sample [FORM IV - IN]

5) Spike Sample Recovery [FORM V (PART 1) - IN]

6) Post Digest Spike Sample Recovery [FORM V (PART 2) - IN]

7) Duplicates [FORM VI - IN]

8) Laboratory Control Sample [FORM VII - IN]

9) Standard Addition Results [FORM VIII - IN]

10) ICP Serial Dilutions [FORM IX - IN]

11) Preparation Log [Form XIII - IN]

12) Analysis Run Log [Form XIV - IN]

c. Quarterly Verification of Instrument Parameters

1) Instrument Detection Limits (Quarterly) [FORM X - IN]

2) ICP Interelement Correction Factors (Annually) [FORM XI (PART 1) - IN]

3) ICP Interelement Correction Factors (Annually) [FORM XI (PART 2) - IN]

4) ICP Linear Ranges (Quarterly) [FORM XII - IN]

(Note that copies of Quarterly Verification of Instrument Parameters forms for the current quarter must be submitted with each data package.)

d. Raw Data

For each reported value, the Contractor shall include in the data package all raw data used to obtain that value. This applies to all required QA/QC measurements, instrument standardization, as well as all sample analysis results. This statement does not apply to the Quarterly Verification of Instrument Parameters submitted as a part of each data package.

Raw data must contain all instrument readouts used for the sample results. Each exposure or instrumental reading must be provided, including those readouts that may fall below the IDL. All AA and ICP instruments must provide a legible hard copy of the direct real-time instrument readout (i.e., stripcharts, printer tapes, etc.). A photocopy of the instruments direct sequential readout must be included. A hardcopy of the instrument's direct instrument readout for cyanide must be included if the instrumentation has the capability.

The order of raw data in the data package shall be: ICP, Flame AA, Furnace AA, Mercury, and Cyanide. All raw data shall include concentration units for ICP and absorbances or concentration units for flame AA, furnace AA, Mercury and Cyanide. All flame and furnace AA data shall be grouped by element.

Raw data must be labeled with EPA sample number and appropriate codes, shown in Table 1 following, to unequivocally identify:

1) Calibration standards, including source and prep date.

2) Initial and continuing calibration blanks and preparation blanks.

3) Initial and continuing calibration verification standards, interference check samples, ICP serial dilution samples, CRDL Standard for ICP and AA, Laboratory Control Sample and Post Digestion Spike.

4) Diluted and undiluted samples (by EPA sample number) and all weights, dilutions and volumes used to obtain the reported values. (If the volumes, weights and dilutions are consistent for all samples in a given SDG, a general statement outlining these parameters is sufficient).

5) Duplicates.

6) Spikes (indicating standard solutions used, final spike concentrations, volumes involved). If spike information (source, concentration, volume) is consistent for a given SDG, a general statement outlining these parameters is sufficient.

7) Instrument used, any instrument adjustments, data corrections or other apparent anomalies on the measurement record, including all data voided or data not used to obtain reported values and a brief written explanation.

8) All information for furnace analysis clearly and sequentially identified on the raw data, including EPA sample number, sample and analytical spike data, percent recovery, coefficient of variation, full MSA data, MSA correlation coefficient, slope and intercepts of linear fit, final sample concentration (standard addition

concentration), and type of background correction used: BS for Smith-Heiftje, BD for Deuterium Arc, or BZ for Zeeman.

9) Time and date of each analysis. Instrument run logs can be submitted if they contain this information. If the instrument does not automatically provide times of analysis, these must be manually entered on all raw data for initial and continuing calibration verification and blanks, as well as interference check samples and CRDL standard for ICP.

10) Integration times for AA analyses.

e. Digestion and Distillation Logs

Logs shall be submitted in the following order: digestion logs for ICP, flame AA, furnace AA and mercury preparations, followed by a copy of the distillation log for cyanide. These logs must include: (1) date, (2) sample weights and volumes, (3) sufficient information to unequivocally identify which QC samples (i.e., laboratory control sample, preparation blank) correspond to each batch digested, (4) comments describing any significant sample changes or reactions which occur during preparation, and (5) indication of pH <2 or >12, as applicable.

3. A legible copy of the Sample Traffic Reports submitted in Item A for all of the samples in the SDG. The Traffic Reports shall be arranged in increasing EPA Sample Number order, considering both alpha and numeric designations. A legible photocopy of the SDG cover sheet must also be submitted.

E. Data in Computer Readable Form

The Contractor shall provide a computer-readable copy of the data on data reporting Forms I-XIV for all samples in the Sample Delivery Group, as specified in the Contract Performance/Delivery Schedule. Computer-readable data deliverables shall be submitted on an IBM or IBM-compatible, 5.25 inch floppy double-sided, double density 360 K-byte or a high density 1.2 M-byte diskette or on an IBM or IBM-compatible, 3.5 inch double-sided, double density 720 K-byte or a high density 1.44 M-byte diskette. The data shall be recorded in ASCII, text file format, and shall adhere to the file, record and field specifications listed in Exhibit H, Data Dictionary and Format for Data Deliverables in Computer-Readable Format.

When submitted, floppy diskettes shall be packaged and shipped in such a manner that the diskette(s) cannot be bent or folded, and will not be exposed to extreme heat or cold or any type of electromagnetic radiation. The diskette(s) must be included in the same shipment as the hardcopy data and shall, at a minimum, be enclosed in a diskette mailer.

Table 1

Codes for Labelling Data

Sample	XXXXXX
Duplicate	XXXXXXD
Matrix Spike	XXXXXXS
Serial Dilution	XXXXXXL
Analytical Spike	XXXXXXA
Post Digestion/Distillation Spike	XXXXXXA
MSA:	
Zero Addition	XXXXXX0
First Addition	XXXXXX1
Second Addition	XXXXXX2
Third Addition	XXXXXX3
Instrument Calibration Standards:	
ICP	S or S0 for blank standard
Atomic Absorption and Cyanide	S0, S10,...etc.
Initial Calibration Verification	ICV
Initial Calibration Blank	ICB
Continuing Calibration Verification	CCV
Continuing Calibration Blank	CCB
Interference Check Samples:	
Solution A	ICSA
Solution AB	ICSAB
CRDL Standard for AA	CRA
CRDL Standard for ICP	CRI
Laboratory Control Samples:	
Aqueous (Water)	LCSW
Solid (Soil/Sediment)	LCSS
Preparation Blank (Water)	PBW
Preparation Blank (Soil)	PBS
Linear Range Analysis Standard	LRS

Notes:

1. When an analytical spike or MSA is performed on samples other than field samples, the "A", "0", "1", "2" or "3" suffixes must be the last to be added to the EPA Sample Number. For instance, an analytical spike of a duplicate must be formatted "XXXXXXDA."

2. The numeric suffix that follows the "S" suffix for the standards indicates the true value of the concentration of the standard in ug/L.

3. ICP calibration standards usually consist of several analytes at different concentrations. Therefore, no numeric suffix can follow the ICP calibration standards unless all the analytes in the standard are prepared at the same concentrations. For instance, the blank for ICP must be formatted "S0."

4. The CRDL standard for AA is considered to be a calibration standard if it was a part of the calibration curve, thus it must be formatted like any other standard. The "CRA" format must be used if the CRDL standard for AA is not used to establish the calibration curve.

F. Results of Intercomparison/Performance Evaluation(PE) Sample Analyses

Tabulation of analytical results for Intercomparison/PE Sample analyses include all requirements specified in items D. and E., above.

G. Compilation of Complete Case File Purge

Within 7 days after data submission, the Contractor shall have compiled the Complete Case File Purge package described in item H., following.

H. Complete Case File Purge

The Complete Case File Purge package includes all laboratory records received or generated for a specific Case that have not been previously submitted to EPA as a deliverable. These items shall be submitted along with their Case File Document Inventory (see Exhibit F, paragraph 2.4 for description of document numbering and inventory procedure). These items include, but are not limited to: sample tags, custody records, sample tracking records, analysts logbook pages, bench sheets, instrument readout records, computer printouts, raw data summaries, instrument logbook pages (including instrument conditions), correspondence, and the document inventory.

Shipment of the Complete Case File Purge package by first class mail, overnight carrier, priority mail or equivalent is acceptable. Custody seals, which are provided by EPA, must be placed on shipping containers and a document inventory and transmittal letter included. The Contractor is not required to maintain any documents for a sample Case after submission of the Complete Case File Purge package; however, the Contractor should maintain a copy of the document inventory and transmittal letter.

I. Quarterly Verification of Instrument Parameters

The Contractor shall perform and report quarterly verification of instrument detection limits and linear range by methods specified in Exhibit E for each instrument used under this contract. For the ICP instrumentation and methods, the Contractor shall also report quarterly interelement correction factors (including method of determination), wavelengths used, and integration times. Quarterly Verification of Instrument Parameters forms for the current quarter shall be submitted in each Sample Delivery Group data package, using Forms X, XI and XII. Submission of Quarterly Verification of Instrument Parameters shall include the raw data used to determine those values reported.

LEVEL C

Deliverables

Data Set Deliverables for Level C QA

	Method Requirements	Deliverables
Organics	- Method blank spikes with results and control charts. Run with each batch of samples processed.	Control Chart
	- Results to be reported on CLP Form 1 or spreadsheet per Sect. 9. Sample results using CLP data flags.	Form 1 or Sect. 9 1/Sample chromatograms/and mass spectra
	- Surrogate recovery from samples reported on CLP Form 2. Surrogates to be used in volatiles, semivolatiles, pesticides/PCB. For volatiles by GC, the names of surrogates should be changed to reflect the surrogate used.	Form 2
	- Matrix spike/spike duplicate 1 spike and spike duplicate per 20 samples of similar matrix reported on Form 3.	Form 3
	- Method blank reported on CLP Form 4.	Form 4 or Sect. 9
	For volatiles by GC, a similar format will be used as CLP Form 4 for blanks.	
	- GC/MS tuning for volatiles/semi-volatiles. Report results on Form 5.	Form 5
	- Initial calibration data reported on Form 6.	Form 6
	For volatiles by GC, the initial calibration data with response factors must be reported.	No Form
	For pesticide/PCB data Form 9 must be used for calibration data.	Form 9
	- Continuing calibration GC/MS data reported on Form 7.	Form 7
	For volatiles, GC data, the response factors and their percent differences from the initial must be reported.	No Form

	Method Requirements	Deliverables
Organics (cont)	- Internal Standard Area for Volatiles and Semivolatiles.	Form 8
	- For pesticides/PCB data, the CLP Form 9 must be presented.	Form 9
	No chromatograms or mass spectra are presented for calibration. These data should be filed in the laboratory and available if problems arising in reviewing/ validating the data. The calibration information should be available for checking during on-site audits.	
	- Internal standard area for GC/MS analyses CLP Form VIII shall be supplied.	
	- Second column confirmation shall be done for all GC work when compounds are detected above reporting limits. Chromatograms of confirmation must be provided.	Chromatograms
Metals	- Level C, requirements	Deliverables
	- Sample results with CLP flagging system	CLP Form 1 or Sect. 9
	- Initial and continuing calibration	CLP Form 2, Part 1 only
	- Blanks 10% frequency	Form 3
	- Method blank taken through digestion (1/20 samples of same matrix)	Form 3 or Sect. 9
	- ICP interference check sample	Form 4
	- Matrix spike recovery (1 per 20 samples of similar matrix)	Form 5, Part 1
	- Postdigestion spike sample recovery for ICP metals. Only done if predigest spike recovery exceed CLP limits.	Form 5, Part 2 (never used for GFAA work)
	- Postdigest spike for GFAA	Recovery will be noted on raw data

	Method Requirements	Deliverables
Metals (Cont)	- Duplicates (1 per 20 samples will be split and digested as separate)	Form 6 samples
	- Method blank spike information will be plotted on control chart, one per batch of samples processed.	Control chart
	- Standard addition. The decision process outlined in CLO page E-3 will be used to determine when standard additions are required.	Form 8
	Holding times.	Form 10
Wet Chemistry	Level C	
	- Blank spike 1/batch	Control chart
	- Method blank 1/batch	Report result No format
	- Sample results	Report result No format
	- Matrix spike/spike duplicate or calibration information	Report result if applicable
	- Calibration check report percent RSD or percent difference from initial calibration	Report percent or percent difference No format

LABORATORY DATA VALIDATION
FUNCTIONAL GUIDELINES FOR EVALUATING ORGANICS ANALYSES

Prepared for the

HAZARDOUS SITE EVALUATION DIVISION
U.S. ENVIRONMENTAL PROTECTION AGENCY

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February 1, 1988

TABLE OF CONTENTS

LABORATORY DATA VALIDATION

FUNCTIONAL GUIDELINES FOR EVALUATING ORGANICS ANALYSES

INTRODUCTION

This document is designed to offer guidance in laboratory data evaluation and validation. In some aspects, it is equivalent to a Standard Operating Procedure (SOP). In other, more subjective areas, only general guidance is offered due to the complexities and uniqueness of data relative to specific samples. These Guidelines have been updated to include all requirements in the 10/86 Statement of Work (SOW) for Organics and 10/86 SOW for Volatiles.

Those areas where specific SOPs are possible are primarily areas in which definitive performance requirements are established. These areas also correspond to specific requirements in Agency contracts. These requirements are concerned with specifications that are not sample dependent; they specify performance requirements on matters that should be fully under a laboratory's control. These specific areas include blanks, calibration standards, performance evaluation standard materials, and tuning. In particular, mistakes such as calculation and transcription errors must be rectified by resubmission of corrected data sheets.

This document is intended for technical review. Some areas of overlap between technical review and Contract Compliance Screening (CCS) exist; however, contract compliance is not intended to be a goal of these guidelines. It is assumed that the CCS is available and can be utilized to assist in the data review procedure.

Some requirements are not identical for every Case or batch of samples. Requirements for frequency of Quality Control (QC) actions are dependent on the number of samples, sample preparation technique, time of analysis, etc. Specific Case requirements and the impact of nonconformance must be addressed on a case by case basis; no specific guidance is provided. For example, there is a contract requirement that a blank analysis be performed a minimum of once every twelve hours of analysis time. This requirement must be translated into the number of blanks required for a specific set of samples; the data reviewer may have to consider the impact on data quality for a sample analyzed thirteen hours after a blank, in terms of the acceptability of that particular sample.

At times, there may be an urgent need to use data which do not meet all contract requirements and technical criteria. Use of these data does <u>not</u> constitute either a new requirement standard or full acceptance of the data. Any decision to utilize data for which performance criteria have not been met is strictly to facilitate the progress of projects requiring the availability of the data. A contract laboratory submitting data which are out of specification may be required to rerun or resubmit data even if the previously submitted data have been utilized due to urgent program needs; data which do not meet specified requirements are never fully acceptable. The only exception to this requirement is in the area of requirements for individual sample analysis; if the nature of the sample itself limits the attainment of specifications, appropriate allowances must be made. The overriding concern of the Agency is to obtain data which are technically valid and legally defensible.

All data reviews must have, as a cover sheet, the Organic Regional Data Assessment (ORDA) form. If mandatory actions are required, they should be specifically noted on this form. In addition, this form is to be used to summarize overall deficiencies requiring attention, as well as general laboratory performance and any discernible trends in

the quality of the data. (This form is not a replacement for the data review.) Sufficient supplementary documentation must accompany the form to clearly identify the problems associated with a Case. The form and any attachments must be submitted to the Contract Laboratory Program Quality Assurance Officer (CLP QAO), the Regional Deputy Project Officer (DPO), and the Environmental Monitoring Systems Laboratory in Las Vegas (EMSL/LV).

It is the responsibility of the data reviewer to notify the Regional DPO concerning problems and shortcomings with regard to laboratory data. If there is an urgent requirement, the DPO may be contacted by telephone to expedite corrective action. It is recommended that all items for DPO action be presented at one time. In any case, the Organic Regional Data Assessment form must be completed and submitted.

PRELIMINARY REVIEW

In order to use this document effectively, the reviewer should have a general overview of the Case at hand. The exact number of samples, their assigned numbers, their matrix, and the number of laboratories involved in their analysis are essential information. Background information on the site is helpful but often this information is very difficult to locate. The site project officer is the best source for answers or further direction.

CCS is a source of a large quantity of summarized information. It can be used to alert the reviewer of problems in the Case or what may be sample-specific problems. This information may be utilized in data validation. If CCS is unavailable, those criteria affecting data validity must be addressed by the data reviewer.

Cases routinely have unique samples which require special attention by the reviewer. Field blanks, field duplicates, and performance audit samples need to be identified. The sampling records should provide:

1. Project Officer for site
2. Complete list of samples with notations on
   a) sample matrix
   b) blanks*
   c) field duplicates*
   d) field spikes*
   e) QC audit sample*
   f) shipping dates
   g) labs involved

   * If applicable

The chain-of-custody record includes sample descriptions and date of sampling. Although sampling date is not addressed by contract requirements, the reviewer must take into account lag times between sampling and shipping while assessing sample holding times.

The Case Narrative is another source of general information. Notable problems with matrices, insufficient sample volume for analysis or reanalysis, and unusual events should be found in the Narrative.

VOLATILES AND SEMIVOLATILES
PROCEDURE

The requirements to be checked in validation are listed below: ("CCS" indicates that the contractual requirements for these items will also be checked by CCS; CCS requirements are not always the same as the data review criteria.)

I. Holding Times (CCS - Lab holding times only)

II. GC/MS Tuning

III. Calibration

- o Initial (CCS)
- o Continuing (CCS)

IV. Blanks (CCS)

V. Surrogate Recovery (CCS)

VI. Matrix Spike/Matrix Spike Duplicate (CCS)

VII. Field Duplicates

VIII. Internal Standards Performance (CCS)

IX. TCL Compound Identification

X. Compound Quantitation and Reported Detection Limits

XI. Tentatively Identified Compounds

XII. System Performance (CCS)

XIII. Overall Assessment of Data for a Case

I. HOLDING TIMES

A. Objective

The objective is to ascertain the validity of results based on the holding time of the sample from time of collection to time of analysis or sample preparation, as appropriate.

B. Criteria

Technical requirements for sample holding times have only been established for water matrices. The holding times for soils are currently under investigation. When the results are available they will be incorporated into the data evaluation process. On October 26, 1984 in Volume 49, Number 209 of the Federal Register, page 43260, the following holding time requirements were established under 40 CFR 136 (Clean Water Act):

> Purgeables: If unpreserved, aromatic volatiles must be analyzed within 7 days and non-aromatic volatiles must be analyzed within 14 days. If preserved with hydrochloric acid and stored at 4°C, then both aromatic and non-aromatic volatiles must be analyzed within 14 days.
>
> Extractables (Includes Base/Neutrals and Acids): Both samples and extracts must be preserved at 4°C. Samples must be extracted within 7 days and the extract must be analyzed within 40 days.

C. Evaluation Procedure

Actual holding times are established by comparing sampling date on the EPA Sample Traffic Report with dates of analysis and/or extraction on Form I. Examine the sample records to determine if samples were properly preserved. (If there is no indication of preservation, it must be assumed that the samples are unpreserved.)

D. Action

If 40 CFR 136 holding times are exceeded, flag all positive results as estimated (J) and sample quantitation limits as estimated (UJ) and document that holding times were exceeded.

The following table illustrates when the qualifiers are to be used for volatiles:

Matrix	Preserved	> 7 Days	> 14 Days
Water	No	All aromatics	All compounds
	Yes	None	All compounds

1. If holding times are grossly exceeded, either on the first analysis or upon re-analysis, the reviewer must use professional judgment to determine the reliability of the data and the effects of additional storage on the sample results. The reviewer may determine that non-detect data are unusable (R).

2. Due to limited information concerning holding times for soil samples, it is left to the discretion of the data reviewer to apply water holding time criteria to soil samples.

II. GC/MS TUNING

A. Objective

Tuning and performance criteria are established to ensure mass resolution, identification and, to some degree, sensitivity. These criteria are not sample specific; conformance is determined using standard materials. Therefore, these criteria should be met in all circumstances.

B. Criteria

1. Decafluorotriphenylphosphine (DFTPP)

m/z	ION ABUNDANCE CRITERIA
51	30.0 - 60.0 % of m/z 198
68	less than 2.0% of m/z 69
70	less than 2.0 % of m/z 69
127	40.0 - 60.0% of m/z 198
197	less than 1.0 % of m/z 198
198	base peak, 100% relative abundance
199	5.0 - 9.0% of m/z 198
275	10.0 - 30.0% of m/z 198
365	greater than 1.00% of m/z 198
441	present, but less than m/z 443
442	greater than 40.0% of m/z 198
443	17.0 - 23.0% of m/z 442

2. Bromofluorobenzene (BFB)

m/z	ION ABUNDANCE CRITERIA
50	15.0 - 40.0% of the base peak
75	30.0 - 60.0% of the base peak
95	base peak, 100% relative abundance
96	5.0 - 9.0% of the base peak
173	less than 2.0% of m/z 174
174	greater than 50.0% of the base peak
175	5.0 - 9.0% of m/z 174
176	greater than 95.0%, but less than 101.0% of m/z 174
177	5.0 - 9.0% of m/z 176

Note: As contracts are modified, new criteria would then apply.

C. Evaluation Procedure

1. Verify from the raw data that the mass calibration is correct.

2. Compare the data presented on each GC/MS Tuning and Mass Calibration (Form V) with each mass listing submitted.

3. Ensure the following:

   a. Verify that Form V is present for each 12-hour period samples are analyzed.

   b. The laboratory has not made any transcription errors.

   c. The appropriate number of significant figures has been reported (number of significant figures given for each ion in the ion abundance criteria column).

   d. The laboratory has not made any calculation errors. For example, the % mass of m/z 443 relative to the mass of m/z 442 is calculated using the following equation:

$$\% \text{ abundance} = \frac{\text{relative abundance of m/z 443}}{\text{relative abundance of m/z 442}} \times 100$$

4. If possible, verify that spectra were generated using appropriate background subtraction techniques. Since the DFTPP and BFB spectra are obtained from chromatographic peaks that should be free from coelution problems, background subtraction should be straightforward and designed only to eliminate column bleed or instrument background ions. Background subtraction actions resulting in spectral distortions for the sole purpose of meeting the contract specifications are contrary to the quality assurance objectives and are therefore unacceptable.

D. Action

1. If mass calibration is in error, classify all associated data as unusable (R).

2. If ion abundance criteria are not met and the data in question are needed on a priority basis, professional judgment may be applied to determine to what extent the data may be utilized. Guidelines to aid in the application of professional judgment to this topic are discussed as follows:

   a. DFTPP — The most critical factors in the DFTPP criteria are the non-instrument specific requirements that are also not unduly affected by the location of the spectrum on the chromatographic profile. The m/z 198/199 and 442/443 ratios are critical. These ratios are based on the natural abundances of Carbon 12 and Carbon 13 and should always be met. Similarly, the m/z 68, 70, 197, and 441 relative abundances indicate the condition of the instrument and the suitability of the resolution adjustment and are very important. Note that all of the foregoing abundances relate to adjacent ions — they are relatively insensitive to differences in instrument design and position of the spectrum on the chromatographic profile. For the ions at m/z 51, 127, and 275, the actual relative abundance is not as critical. For instance, if m/z 275 has 40% relative abundance (criteria- 10-30%) and other criteria are met, the deficiency is minor. The relative abundance of

m/z 365 is an indicator of suitable instrument zero adjustment. If m/z 365 relative abundance is zero, minimum detection limits may be affected. On the other hand, if m/z 365 is present, but less than the 1% minimum abundance criteria, the deficiency is not as serious.

b. BFB — As with DFTPP, the most important factors to consider are the empirical results that are relatively insensitive to location on the chromatographic profile and the type of instrumentation. Therefore, the critical ion abundance criteria for BFB are the m/z 95/96 ratio, the 174/175 ratio, the 176/177 ratio, and the 174/176 ratio. The relative abundances of m/z 50 and 75 are of lower importance.

3. In line with the above discussion, an expansion of minus 25% of the low limit and plus 25% of the high limit for selected ions may be appropriate. For example, in DFTPP the m/z 51 ion abundance criteria might be expanded from 30-60% of m/z 198 to 22-75% of m/z 198.

a. The complete expanded criteria for DFTPP and BFB are as follows:

1) Decafluorotriphenylphosphine (DFTPP) (Expanded Criteria)*

m/z	ION ABUNDANCE CRITERIA
51	22.0 - 75.0% of m/z 198
68	less than 2.0% of m/z 69
70	less than 2.0% of m/z 69
127	30.0 - 75.0% of m/z 198
197	less than 1.0% of m/z 198
198	base peak, 100% relative abundance
199	5.0 - 9.0% of m/z 198
275	7.0 - 37.0% of m/z 198
365	greater than 0.75% of m/z 198
441	present, but less than m/z 443
442	greater than 30.0% of m/z 198
443	17.0 - 23.0% of m/z 442

2) Bromofluorobenzene (BFB) (Expanded Criteria)*

m/z	ION ABUNDANCE CRITERIA
50	11.0 - 50.0% of the base peak
75	22.0 - 75.0% of the base peak
95	base peak, 100% relative abundance
96	5.0 - 9.0% of the base peak
173	less than 2% of the base peak
174	greater than 50% of the base peak
175	5.0 - 9.0% of m/z 174
176	greater than 95%, but less than 101% of m/z 174
177	5.0 - 9.0% of m/z 176

*Note: Does NOT change contract requirements.

b. If results fall within these expanded criteria, data may be acceptable.

c. If results fall outside these expanded criteria, all data are unusable (R).

d. These criteria do NOT establish new contract requirements. Contract laboratories meeting expanded criteria but not meeting contract requirements are NOT in compliance.

e. Decisions to use analytical data associated with DFTPP and BFB tunes not meeting contract requirements should be clearly noted on the Organic Regional Data Assessment Form.

f. If the reviewer has reason to believe that tuning criteria were achieved using techniques that distorted or skewed the spectra, full documentation on the tuning quality control should be obtained. If the techniques employed are found to be at variance with accepted practices, the quality assurance program of the laboratory may merit evaluation.

g. It is up to the reviewer's discretion, based on professional judgment, to flag data associated with tunes meeting expanded criteria, but not basic criteria. If only one element falls within the expanded criteria, no qualification may be needed. On the other hand, if several data elements are in the expanded windows, all associated data may merit an estimated flag (J). Please note that the data reviewer is not required to use expanded criteria. The reviewer may still choose to flag all data associated with a tune not meeting contract criteria as unusable (R) if it is deemed appropriate.

III. CALIBRATION

A. Objective

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable quantitative data. Initial calibration demonstrates that the instrument is capable of acceptable performance in the beginning, and continuing calibration checks document satisfactory maintenance and adjustment of the instrument on a day-to-day basis.

B. Criteria

1. Initial Calibration

a. Volatile and Semivolatile Fractions

1) All average Relative Response Factors ($\overline{RRF}$) for TCL compounds must be ≥ 0.05.

2) All Percent Relative Standard Deviations (%RSD) must be $\leq 30\%$.

ng Calibration

'olatile and Semivolatile Fractions

) All Relative Response Factors (RRF) for TCL compounds must be $\geq$ 0.05.

:) All Percent Difference (%D) must be $\leq$ 25%.

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:alibration

Evaluate the $\overline{RRF}$ for all TCL compounds and verify the following:

1) Check and recalculate the RRF and $\overline{RRF}$ for one or more volatile and semivolatile TCL compounds; verify that the recalculated value(s) agrees with the laboratory reported value(s).

2) Verify that all volatile and semivolatile TCL compounds have average Relative Response Factors of at least 0.05.

Evaluate the Percent Relative Standard Deviation (%RSD) for all TCL compounds and verify the following:

$$\sigma = \sqrt{\sum_{i=1}^{n} \frac{(x_i - \overline{x})^2}{(n-1)}}$$

$$\% \text{ RSD} = \frac{\sigma}{\overline{x}} \times 100$$

σ = Standard deviation of 5 response factors

$\overline{x}$ = Mean of 5 response factors

1) Check and recalculate the %RSD for one or more TCL compounds; verify that the recalculated value agrees with the laboratory reported value.

2) Verify that all TCL compounds (volatile and semivolatile) have a %RSD of $\leq$ 30%.

If errors are detected in the calculations of either the $\overline{RRF}$ or the %RSD, perform a more comprehensive recalculation.

2. Continuing Calibration

a. Evaluate the RRF for all TCL compounds:

1) Verify that all volatile and semivolatile TCL compounds have Relative Response Factors of at least 0.05.

b. Evaluate the Percent Difference and verify the following:

1) Check calculation of % Difference (%D) between initial calibration average Relative Response Factors and continuing calibration Relative Response Factors for one or more compounds, using the following equation:

$$\%D = \frac{\overline{RRF_I} - RRF_C}{\overline{RRF_I}} \times 100$$

where,

$\overline{RRF_I}$ = average relative response factor from initial calibration.

RRF_C = relative response factor from continuing calibration standard.

2) Verify that the %D is $\leq$ 25% for all volatile and semivolatile TCL compounds.

c. If errors are detected in the calculations of either the RRF or the %D, perform a more comprehensive recalculation.

D. Action

1. Initial Calibration

a. If any volatile or semivolatile TCL compound result has an average Relative Response Factor of less than 0.05:

1) Flag positive results for that compound as estimated (J).

2) Flag non-detects for that compound as unusable (R).

b. If any volatile or semivolatile TCL compound has a % RSD of greater than 30%:

1) Flag positive results for that compound as estimated (J).

2) Non-detects may be qualified using professional judgment.

2. Continuing Calibration

a. If any volatile or semivolatile TCL compound has a Relative Response Factor of less than 0.05:

1) Flag positive results for that compound as estimated (J).

2) Flag non-detects for that compound as unusable (R).

b. If any volatile or semivolatile TCL compound has a % Difference between Initial and Continuing Calibration of greater than 25%:

1) Flag all positive results for that compound as estimated (J).

2) Non-detects may be qualified using professional judgment.

IV. BLANKS

A. Objective

The assessment of blank analysis results is to determine the existence and magnitude of contamination problems. The criteria for evaluation of blanks apply to any blank associated with the samples. If problems with any blank exist, all data associated with the Case must be carefully evaluated to determine whether or not there is an inherent variability in the data for the Case, or if the problem is an isolated occurrence not affecting other data.

B. Criteria

No contaminants should be present in the blank(s).

C. Evaluation Procedure

1. Review the results of all associated blank(s), Form I(s) and raw data (chromatograms, reconstructed ion chromatograms, quantitation reports or data system printouts).

2. Verify that Method Blank analysis has been reported per matrix, per concentration level, for each GC/MS system used to analyze VOA samples, and for each extraction batch for semivolatiles. The reviewer can use the Method Blank Summary (Form IV) to assist in identifying samples associated with each Method Blank.

D. Action

Action in the case of unsuitable blank results depends on the circumstances and origin of the blank. No positive sample results should be reported unless the concentration of the compound in the sample exceeds 10 times the amount in any blank for the common contaminants listed below, or 5 times the amount for other compounds. In instances where more than one blank is associated with a given sample, qualification should be based upon a comparison with the associated blank having the highest concentration of a contaminant. The results must not be corrected by subtracting any blank value. Specific actions are as follows:

1. If a compound is found in a blank but not found in the sample, no action is taken.

2. Any compound (other than the five listed below) detected in the sample, which was also detected in any associated blank, must be qualified when the sample concentration is less than five times the blank concentration. For the following five compounds, the results are qualified by elevating the limit of detection when the sample concentration is less than 10 times the blank concentration.

   Common lab contaminants:

   a. Methylene chloride
   b. Acetone
   c. Toluene
   d. 2-butanone
   e. Common phthalate esters

   The reviewer should note that the blank analyses may not involve the same weights, volumes, or dilution factors as the associated samples. These factors must be taken into consideration when applying the 5x and 10x criteria, such that a comparison of the total amount of contamination is actually made.

   Additionally, there may be instances where little or no contamination was present in the associated blanks, but qualification of the sample was deemed necessary. Contamination introduced through dilution water is one example. Although it is not always possible to determine, instances of this occurring can be detected when contaminants are found in the diluted sample result, but are absent in the undiluted sample result. Since both results are not routinely reported, it may be impossible to verify this source of contamination. However, if the reviewer determines that the contamination is from a source other than the sample, he/she should qualify the data. In this case, the 5x or 10x rule does not apply; the sample value should be reported as a non-detect.

3. The following are examples of applying the blank qualification guidelines. Certain circumstances may warrant deviations from these guidelines.

   Case 1: Sample result is greater than the Contract Required Quantitation Limit (CRQL), but is less than the required amount (5x or 10x) from the blank result.

	Rule	
	10x	5x
Blank Result	7	7
CRQL	5	5
Sample Result	60	30
Qualified Sample Result	60U	30U

   In the example for the 10x rule, sample results less than 70 (or 10 x 7) would be qualified as non-detects. In the case of the 5x rule, sample results less than 35 (or 5 x 7) would be qualified as non-detects.

Case 2: Sample result is less than CRQL, and is also less than the required amount (5x or 10x) from the blank result.

	Rule	
	10x	5x
Blank Result	6	6
CRQL	5	5
Sample Result	4J	4J
Qualified Sample Result	5U	5U

Note that data are not reported as 4U, as this would be reported as a detection limit below the CRQL.

Case 3: Sample result is greater than the required amount (5x or 10x) from the blank result.

	Rule	
	10x	5x
Blank Result	10	10
CRQL	5	5
Sample Result	120	60
Qualified Sample Result	120	60

For both the 10x and 5x rules, sample results exceeded the adjusted blank results of 100 (or 10x10) and 50 (or 5x10), respectively.

4. If gross contamination exists (i.e., saturated peaks by GC/MS), all compounds affected should be flagged as unusable (R), due to interference, in all samples affected.

5. If inordinate amounts of other TCL compounds are found at low levels in the blank(s), it may be indicative of a problem at the laboratory and should be noted in the data review comments which are forwarded to the DPO.

6. Similar consideration should be given to TIC compounds which are found in both the sample and associated blank(s). (See Section XI for TIC guidance.)

V. SURROGATE RECOVERY

A. Objective

Laboratory performance on individual samples is established by means of spiking activities. All samples are spiked with surrogate compounds prior to sample preparation. The evaluation of the results of these surrogate spikes is not necessarily straightforward. The sample itself may produce effects due to such factors as interferences and high concentrations of analytes. Since the effects of the sample matrix are frequently outside the control of the laboratory and may present relatively unique problems, the review and validation of data based on specific sample results is

frequently subjective and demands analytical experience and professional judgment. Accordingly, this section consists primarily of guidelines, in some cases with several optional approaches suggested.

B. Criteria

Sample and blank surrogate recoveries for volatiles and semivolatiles must be within limits as per applicable SOW (Form II).

C. Evaluation Procedure

1. Check raw data (i.e., chromatograms, quant list, etc.) to verify the recoveries on the Surrogate Recovery (Form II).

2. The following should be determined from the Surrogate Recovery form(s):

   a. If any <u>two</u> surrogates within a base/neutral or acid fraction (or one surrogate for the VOA fraction) are out of specification, or if any one base/neutral, acid or VOA surrogate has a recovery of less than 10%, then there should be a reanalysis with surrogate results still outside the criteria. (<u>Note</u>: When there are unacceptable surrogate recoveries followed by successful re-analyses, the labs are required to report only the successful run.)

   b. The lab has failed to perform satisfactorily if surrogate recoveries are out of specification with no evidence of repurging, reinjection, or re-extraction.

   c. Verify that no blanks have surrogates outside the criteria.

3. Any time there are two or more analyses for a particular fraction the reviewer must determine which are the best data to report.

   Considerations should include:

   a. Surrogate recovery (marginal vs. gross deviation).

   b. Holding times.

   c. Comparison of the values of the TCL compounds reported in each fraction.

D. Action

For surrogate spike recoveries out of specification, the following approaches are suggested based on a review of all data from the case, especially considering the apparent complexity of the sample matrix:

1. If at least <u>two</u> surrogates in a base/neutral or acid fraction or one surrogate in the volatile fraction are out of specification, but have recoveries greater than 10%:

   a. Positive results for that fraction are flagged as estimated (J).

b. Negative results for that fraction are flagged with the sample quantitation limit as estimated (UJ).

2. If any surrogate in a fraction shows less than 10% recovery:

a. Positive results for that fraction are flagged as estimated (J).

b. Negative results for that fraction are flagged as unusable (R).

3. No qualification with respect to surrogate recovery is placed on data unless at least two surrogates are out of specification in the base/neutral or acid fraction, or one in the volatile fraction, or unless any surrogate has a less than 10% recovery.

4. In the special case of a blank analysis with surrogates out of specification, the reviewer must give special consideration to the validity of associated sample data. The basic concern is whether the blank problems represent an isolated problem with the blank alone, or whether there is a fundamental problem with the analytical process. For example, if one or more samples in the batch show acceptable surrogate recoveries, the reviewer may choose to consider the blank problem to be an isolated occurrence. However, even if this judgment allows some use of the affected data, analytical problems remain that must be corrected by the laboratory.

VI. MATRIX SPIKE/MATRIX SPIKE DUPLICATE

A. Objective

These data are generated to determine long-term precision and accuracy of the analytical method on various matrices. These data alone cannot be used to evaluate the precision and accuracy of individual samples.

B. Criteria

1. Spike recoveries must be within the advisory limits established in the appropriate IFB and on Form III.

2. Relative Percent Differences (RPD) between matrix spike and matrix spike duplicate recoveries must be within the advisory limits established in the appropriate IFB and on Form III.

C. Evaluation Procedure

1. Inspect results for the Matrix Spike/Matrix Spike Duplicate Recovery (Form III).

2. Verify transcriptions from raw data and verify calculations.

D. Action

No action is taken on Matrix Spike/Matrix Spike Duplicate (MS/MSD) data alone to qualify an entire Case. However, using informed professional judgment the data reviewer may use the matrix spike and matrix spike duplicate results in conjunction with other QC criteria and determine the need for some qualification of the data.

The data reviewer should first try to determine to what extent the results of the MS/MSD affect the associated data. This determination should be made with regard to the MS/MSD sample itself as well as specific analytes for all samples associated with the MS/MSD.

In those instances where it can be determined that the results of the MS/MSD affect only the sample spiked, then qualification should be limited to this sample alone. However, it may be determined through the MS/MSD results that a lab is having a systematic problem in the analysis of one or more analytes, which affects all associated samples.

Note: If a field blank was used for the MS/MSD, the information must be included on the ORDA form.

VII. FIELD DUPLICATES

A. Objective

Field duplicate samples may be taken and analyzed as an indication of overall precision. These analyses measure both field and lab precision; therefore, the results may have more variability than lab duplicates which measure only lab performance. It is also expected that soil duplicate results will have a greater variance than water matrices due to difficulties associated with collecting identical field samples.

B. Criteria

There are no specific review criteria for field duplicate analyses comparability.

C. Evaluation Procedures

Samples which are field duplicates should be identified using EPA Sample Traffic Reports or sample field sheets. The reviewer should compare the results reported for each sample and calculate the Relative Percent Difference (RPD).

D. Action

Any evaluation of the field duplicates should be provided with the reviewer's comments.

VIII. INTERNAL STANDARDS PERFORMANCE

A. Objective

Internal Standards (IS) performance criteria ensure that GC/MS sensitivity and response is stable during every run.

B. Criteria

1. Internal standard area counts must not vary by more than a factor of two (-50% to +100%) from the associated calibration standard.

2. The retention time of the internal standard must not vary more than ±30 seconds from the associated calibration standard.

C. Evaluation Procedure

1. Check raw data (i.e., chromatograms, quantitation lists, etc.) to verify the recoveries reported on the Internal Standard Area Summary (Form VIIIA, VIIIB).

2. Verify that all retention times and IS areas are acceptable.

3. Any time there are two analyses for a particular fraction, the reviewer must determine which are the best data to report. Considerations should include:

   a. Magnitude of the shift.

   b. Holding times.

   c. Comparison of the values of the TCL compounds reported in each fraction.

D. Action

1. If an IS area count is outside -50% or +100% of the associated standard:

   a. Positive results for compounds quantitated using that IS are flagged as estimated (J) for that sample fraction.

   b. Non-detects for compounds quantitated using that IS are flagged with the sample quantitation limit classified as estimated (UJ) for that sample fraction.

   c. If extremely low area counts are reported, or if performance exhibits a major abrupt drop-off, then a severe loss of sensitivity is indicated. Non-detects should then be flagged as unusable (R).

2. If an IS retention time varies by more than 30 seconds, the chromatographic profile for that sample must be examined to determine if any false positives or negatives exist. For shifts of a large magnitude, the reviewer may consider partial or total rejection of the data for that sample fraction.

IX. TCL COMPOUND IDENTIFICATION

A. Objective

The objective of the criteria for GC/MS qualitative analysis is to minimize the number of erroneous identifications of compounds. An erroneous identification can either be a false positive (reporting a compound present when it is not) or a false negative (not reporting a compound that is present).

The identification criteria can be applied much more easily in detecting false positives than false negatives. More information is available due to the requirement for submittal of data supporting positive identifications. Negatives, or non-detected compounds, on the other hand represent an absence of data and are, therefore, much more difficult to assess.

B. Criteria

1. Compound must be within ±0.06 relative retention time (RRT) units of the standard RRT.

2. Mass spectra of the sample compound and a current laboratory-generated standard must match according to the following criteria:

   a. All ions present in the standard mass spectrum at a relative intensity greater than 10% must be present in the sample spectrum

   b. The relative intensities of ions specified above must agree within ±20% between the standard and sample spectra. (Example: For an ion with an abundance of 50% in the standard spectrum, the corresponding sample ion abundance must be between 30% and 70%.)

   c. Ions greater than 10% in the sample spectrum but not present in the standard spectrum must be considered and accounted for.

C. Evaluation Procedure

1. Check that the RRT of reported compounds is within 0.06 RRT units of the reference standard.

2. Check the laboratory standard spectra vs. the sample compound spectra.

3. The reviewer should be aware of situations (e.g., high concentration samples preceding low concentration samples) when sample carry-over is a possibility and should use judgment to determine if instrument cross-contamination has affected any positive compound identification.

D. Action

1. The application of qualitative criteria for GC/MS analysis of TCL compounds requires professional judgment. If it is determined that incorrect identifications were made, all such data should be flagged as not detected (U) or unusable (R).

2. Professional judgment must be used to qualify the data if it is determined that cross-contamination has occurred.

X. COMPOUND QUANTITATION AND REPORTED DETECTION LIMITS

A. Objective

The objective is to ensure that the reported quantitation results and CRQLs are accurate.

B. Criteria

1. Compound quantitation, as well as the adjustment of the CRQL, must be calculated according to the appropriate SOW.

2. Compound RRF must be calculated based on the IS specified in the SOW for that compound. Quantitation must be based on the quantitation ion (m/z) specified in the SOW. The compound quantitation must be based on the RRF from the appropriate daily standard.

C. Evaluation Procedure

1. For all fractions, raw data should be examined to verify the correct calculation of all sample results reported by the laboratory. Quantitation lists, chromatograms, and sample preparation log sheets should be compared to the reported positive sample results and quantitation limits.

2. Verify that the correct internal standard, quantitation ion, and RRF were used to quantitate the compound.

3. Verify that the CRQLs have been adjusted to reflect all sample dilutions, concentrations, splits, clean-up activities, and dry weight factors that are not accounted for by the method.

D. Action

If there are any discrepancies found, the laboratory may be contacted by the designated representative to obtain additional information that could resolve any differences. If a discrepancy remains unresolved, the reviewer must decide which value is the best value. Under these circumstances, the reviewer may determine qualification of data is warranted.

XI. TENTATIVELY IDENTIFIED COMPOUNDS

A. Objective

Chromatographic peaks in volatile and semivolatile fraction analyses that are not target compound list (TCL) analytes, surrogates, or internal standards are potential tentatively identified compounds (TIC). TICs must be qualitatively identified by (GC/MS) library search and the identifications assessed by the data reviewer.

B. Criteria

1. For each sample, the laboratory must conduct a mass spectral search of the NBS library and report the possible identity for the 10 largest VOA fraction peaks and the 20 largest BNA fraction peaks which are not surrogate, internal standard, or TCL compounds, but which have area/height greater than 10 percent of the size of the nearest internal standard. TIC results are reported for each sample on the Organic Analyses Data Sheet (Form I, TIC).

   Note: SOW revision October 1986 does not allow the laboratory to report as tentatively identified compounds (TICs) any TCL compound which is properly reported in another fraction. (For example, late eluting volatile TCL compounds must not be reported as BNA TICs.)

2. Guidelines for tentative identification are as follows:

   a. Major ions (greater than 10% relative intensity) in the reference spectrum should be present in the sample spectrum.

   b. The relative intensities of the major ions should agree within ±20% between the sample and the reference spectra.

   c. Molecular ions present in the reference spectrum should be present in the sample spectrum.

   d. Ions present in the sample spectrum but not in the reference spectrum should be reviewed for possible background contamination, interference, or coelution of additional TIC or TCL compounds.

   e. When the above criteria are not met, but in the technical judgment of the data reviewer or mass spectral interpretation specialist the identification is correct, the data reviewer may report the identification.

   f. If in the data reviewer's judgment the identification is uncertain or there are extenuating factors affecting compound identifications, the TIC result may be reported as "unknown".

C. Evaluation Procedure

1. Check the raw data to verify that the laboratory has generated a library search for all required peaks in the chromatograms (samples and blanks).

2. Blank chromatograms should be examined to verify that TIC peaks present in samples are not found in blanks. When a low-level non-TCL compound that is a common artifact or laboratory contaminant is detected in a sample, a thorough check of blank chromatograms may require looking for peaks which are less than 10 percent of the internal standard height, but present in the blank chromatogram at similar relative retention time.

3. All mass spectra in every sample and blank must be examined.

4. Since TIC library searches often yield several candidate compounds having a close matching score, all reasonable choices must be considered.

5. The reviewer should be aware of common laboratory artifacts/contaminants and their sources (aldol products, solvent preservatives/reagent contaminants, etc.). These may be present in blanks and not reported as sample TICs.

   Examples:

   a. Common lab contaminants: CO_2 (m/e 44), siloxanes (m/e 73), diethyl ether, hexane, certain freons (1,1,2-trichloro-1,2,2-trifluoroethane or fluoro-trichloromethane), phthalates at levels less than 100 ug/l or 4000 ug/kg.

   b. Solvent preservatives: cyclohexene is a methylene chloride preservative. Related by-products include cyclohexanone, cyclohexenone, cyclohexanol, cyclohexenol, chlorocyclohexene, chlorocyclohexanol.

   c. Aldol reaction products of acetone include: 4-hydroxy-4-methyl-2-pentanone, 4-methyl-2-penten-2-one, 5,5-dimethyl-2(5H)-furanone.

6. Occasionally, a TCL compound may be identified in the proper analytical fraction by non-target library search procedures, even though it was not found on the quantitation list. If the total area quantitation method was used, the reviewer should request that the laboratory recalculate the result using the proper quantitation ion. In addition, the reviewer should evaluate other sample chromatograms and check library reference retention times on quantitation lists to determine whether the false negative result is an isolated occurrence or whether data from the entire Case may be affected.

7. TCL compounds may be identified in more than one fraction. Verify that quantitation is made from the proper fraction.

D. Action

1. All TIC results should be flagged as tentatively identified with estimated concentrations (JN).

2. General actions related to the review of TIC results are as follows:

   a. If it is determined that a tentative identification of a non-TCL compound is not acceptable, the tentative identification should be changed to "unknown" or an appropriate identification.

b. If all contractually required peaks were not library searched, the designated representative could request these data from the laboratory.

3. TIC results which are not sufficiently above the level in the blank should not be reported. (Dilutions and sample size must be taken into account when comparing the amounts present in blanks and samples.)

4. When a compound is not found in any blanks, but is a suspected artifact of common laboratory contaminant, the result may be flagged as unusable (R).

5. In deciding whether a library search result for a TIC represents a realistic identification, professional judgment must be exercised. If there is more than one reasonable match, the result may be reported as "either compound X or compound Y." If there is a lack of isomer specificity, the TIC result may be changed to a non-specific isomer result (1,3,5-trimethyl benzene to trimethyl benzene isomer) or to a compound class (2-methyl, 3-ethyl benzene to substituted aromatic compound).

6. The reviewer may elect to report all similar isomers as a total. (All alkanes may be summarized and reported as total hydrocarbons.)

7. Other Case factors may influence TIC judgments. If a sample TIC match is poor but other samples have a TIC with a good library match, similar relative retention time and the same ions, identification information may be inferred from the other sample TIC results.

8. Physical constants, such as boiling point, may be factored into professional judgment of TIC results.

XII. SYSTEM PERFORMANCE

During the period following Instrument Performance QC checks (e.g. blanks, tuning, calibration), changes may occur in the system that degrade the quality of the data. While this degradation would not be directly shown by QC checks until the next required series of analytical QC runs, a thorough review of the ongoing data acquisition can yield indicators of instrument performance.

Some examples of instrument performance indicators for various factors are as follows:

1. Abrupt, discrete shifts in reconstructed ion chromatogram (RIC) baseline may indicate gain or threshold changes.

2. Poor chromatographic performance affects both qualitative and quantitative results. Indications of substandard performance include:

   a. High RIC background levels or shifts in absolute retention times of internal standards.

   b. Excessive baseline rise at elevated temperature.

c. Extraneous peaks.

d. Loss of resolution as suggested by factors such as non-resolution of 2,4- and 2,5- dinitrotoluene.

e. Peak tailing or peak splitting may result in inaccurate quantitation.

Continued analytical activity with degraded performance suggests lack of attention or professional experience. Based on the instrument performance indicators, the data reviewer must decide if the system has degraded to the point of affecting data quality or validity. If data quality may have been affected, data should be qualified using the reviewer's best professional judgment.

XIII. OVERALL ASSESSMENT OF DATA FOR A CASE

It is appropriate for the data reviewer to make professional judgments and express concerns and comments on the validity of the overall data package for a Case. This is particularly appropriate for Cases in which there are several QC criteria out of specification. The additive nature of QC factors out of specification is difficult to assess in an objective manner, but the reviewer has a responsibility to inform users concerning data quality and data limitations in order to assist that user in avoiding inappropriate use of the data, while not precluding any consideration of the data at all. The data reviewer would be greatly assisted in this endeavor if the data quality objectives were provided.

PESTICIDES PROCEDURE

The requirements to be checked in validation are listed below. ("CCS" indicates that the contract requirements for these items will also be checked by CCS; CCS requirements are not always the same as the data review criteria.)

I. Holding Times (CCS - Lab holding times only)

II. Pesticides Instrument Performance (CCS)

III. Calibration

- o Initial (CCS)
- o Analytical Sequence (CCS)
- o Continuing (CCS)

IV. Blanks (CCS)

V. Surrogate Recovery

VI. Matrix Spike/Matrix Spike Duplicate (CCS)

VII. Field Duplicates

VIII. Compound Identification

IX. Compound Quantitation and Reported Detection Limits

X. Overall Assessment of Data for a Case

I. HOLDING TIMES

A. Objective

The objective is to ascertain the validity of results based on the holding time of the sample from time of collection to time of analysis or sample preparation, as appropriate.

B. Criteria

Technical requirements for sample holding times have only been established for water matrices. The holding times for soils are currently under investigation. When the results are available they will be incorporated into the data evaluation process. On October 26, 1984 in Volume 49, Number 209 of the Federal Register, page 43260, the holding time requirements for pesticides were established under 40 CFR 136 (Clean Water Act). Samples must be extracted within 7 days and the extract must be analyzed within 40 days. Both samples and extracts must be stored at 4° C.

C. Evaluation Procedure

Actual holding times are established by comparing sampling date on the EPA Sample Traffic Report with dates of analysis and extraction on Form I. Examine the sample records to determine if samples were properly preserved. (If there is no indication of preservation, it must be assumed that the samples are unpreserved.)

D. Action

If 40 CFR 136 holding times are exceeded, flag all positive results as estimated (J) and sample quantitation limits as estimated (UJ) and document to the effect that holding times were exceeded.

1. If holding times are grossly exceeded, either on the first analysis or upon re-analysis, the reviewer must use professional judgment to determine the reliability of the data and the effect of additional storage on the sample results. The reviewer may determine non-detect data are unusable (R).

2. Due to limited information concerning holding times for soil samples, it is left to the discretion of the data reviewer to apply water holding time criteria to soil samples.

II. PESTICIDES INSTRUMENT PERFORMANCE

A. Objective

These criteria are established to ensure that adequate chromatographic resolution and instrument sensitivity are achieved by the chromatographic system. These criteria are not sample specific; conformance is determined using standard materials. Therefore, these criteria should be met in all circumstances.

B. Criteria

1. DDT Retention Time

DDT must have retention time on packed columns (except OV-1 and OV-101) greater than or equal to 12 minutes.

2. Retention Time Windows

The laboratory must report retention time window data on the Pesticide/PCB Standards Summary (Form IX) for each GC column used to analyze samples.

3. DDT/Endrin Degradation Check

The total percent breakdown for neither DDT nor endrin may exceed 20%. The percent breakdown is the amount of decomposition that endrin and 4,4'-DDT undergo when analyzed by the chromatographic system.

a. For endrin, the percent breakdown is determined by the presence of endrin aldehyde and/or endrin ketone in the GC chromatogram.

b. For 4,4'-DDT, the percent breakdown is determined from the presence of 4,4'-DDD and/or 4,4'-DDE in the GC chromatogram.

c. A combined percent breakdown must be calculated if there is evidence of a peak at the retention time of endrin aldehyde/4,4'-DDD, which co-elute on the OV-1 packed column (or an equivalent column).

d. Percent breakdown is calculated using the following equations:

$$\text{\% Breakdown for 4,4'-DDT} = \frac{\text{Total DDT degradation peak area (DDE + DDD)}}{\text{Total DDT peak area (DDT + DDE + DDD)}} \times 100$$

$$\text{\% Breakdown for endrin} = \frac{\text{Degradation Peak Areas (endrin aldehyde + endrin ketone)}}{\text{Peak Area (endrin + endrin aldehyde + endrin ketone)}} \times 100$$

Note 1: Peak area of endrin aldehyde must be measured during the degradation check to verify system performance. Endrin aldehyde is not reported on Form 1 because it is removed by alumina cleanup.

Note 2: The term "peak height" may be substituted for the term "peak area".

$$\text{Combined \% Breakdown} = \frac{\text{Total degradation peak areas (DDE + DDD + endrin aldehyde + endrin ketone)}}{\text{Total DDT and endrin peak areas (DDT + DDE + DDD + endrin + endrin aldehyde + endrin ketone)}}$$

4. DBC Retention Time Check

The retention time of DBC in each analysis must be compared to the retention time of DBC in Evaluation Standard Mix A. The Percent Difference (%D) must not exceed 2.0% for packed columns, 0.3% for narrow-bore capillary columns, and 1.5% if wide-bore capillary columns are used.

$$\%D = \frac{RT_I - RT_S}{RT_I} \times 100$$

where,

RT_I = Absolute retention time of dibutylchlorendate in the initial standard (Evaluation Standard Mix A).

RT_S = Absolute retention time of dibutylchlorendate in the subsequent analyses.

C. Evaluation Procedure

1. Check raw data to verify that DDT retention time is greater than 12 minutes on the standard chromatogram and that there is adequate resolution between peaks.

2. Check raw data to verify that retention time windows are reported on Form IX, and that all pesticide standards are within the established retention time windows.

3. Check raw data to verify that the percent breakdown for endrin and 4,4'-DDT, or the combined percent breakdown, does not exceed 20% in all Evaluation Standard Mix B analyses on Form VIII D.

4. Check raw data to verify that the percent difference in retention time for dibutylchlorendate in all standards and samples is $\leq$ 2.0% for packed column analysis, $\leq$ 0.3% for capillary column analysis, and $\leq$ 1.5% for wide-bore capillary column analysis on Form VIII E.

D. Action

1. DDT Retention Time

If the retention time of DDT is less than 12 minutes (except on OV-1 and OV-101), a close examination of the chromatography is necessary to ensure that adequate separation of individual components is achieved. If adequate separation is not achieved, flag all affected compound data as unusable (R).

2. Retention Time Windows

Retention time windows are used in qualitative identification. If the standards do not fall within the retention time windows, the associated sample results should be carefully evaluated. All samples injected after the last in-control standard are potentially affected.

a. For the affected samples, check to see if chromatograms contain any peaks within an expanded window surrounding the expected retention time window of the pesticide of interest. If no peaks are present either within or close to the retention time window of the deviant target pesticide compound, there is usually no effect on the data. (Non-detected values can be considered valid.)

b. If the affected sample chromatograms contain peaks which may be of concern (i.e., above the CRQL and either close to or within the expected retention time window of the pesticide of interest), then two options are available to the reviewer to determine the extent of the effect on the data.

1) If no additional effort is warranted by the reviewer, flag all positive results and quantitation limits as unusable (R). The narrative should emphasize the possibility of either false negatives or false positives, as appropriate.

2) In some cases, additional effort is warranted by the reviewer (e.g., if the data are needed on a priority basis and if the peak(s) present might represent a level of concern for that particular pesticide). In these situations, the reviewer may undertake the following additional efforts to determine a usable retention time window for affected samples:

(a) The reviewer should examine the data package for the presence of three or more standards containing the pesticide of interest that were run within a 72-hour period during which the sample was analyzed.

(b) If three or more such standards are present, the mean and standard deviation of the retention time window can be re-evaluated.

(c) If all standards and matrix spikes fall within the revised window, the valid positive or negative sample results can be determined using this window.

(d) The narrative should identify the additional efforts taken by the reviewer and the resultant impact on data usability. In addition, the support documentation should contain all calculations and comparisons generated by the reviewer.

3. DDT/Endrin Degradation Check

a. If DDT breakdown is greater than 20%, beginning with the samples following the last <u>in-control</u> standard:

1) Flag all quantitative results for DDT as estimated (J). If DDT was not detected, but DDD and DDE are positive, then flag the quantitation limit for DDT as unusable (R).

2) Flag results for DDD and/or DDE as presumptively present at an estimated quantity (NJ).

b. If endrin breakdown is greater than 20%:

1) Flag all quantitative results for endrin as estimated (J). If endrin was not detected, but endrin aldehyde and endrin ketone are positive, then flag the quantitation limit for endrin as unusable (R).

2) Flag results for endrin ketone as presumptively present at an estimated quantity (NJ).

4. Retention Time Check

a. If the retention time shift for dibutylchlorendate (DBC) is greater than 2.0% for packed column, greater than 0.3% for narrow-bore capillary column, or greater than 1.5% for wide-bore capillary column, the analysis may be flagged unusable for that sample(s) (R), but qualification of the data is left up to the professional judgment of the reviewer.

b. The retention time shift cannot be evaluated in the absence of DBC.

III. CALIBRATION

A. Objective

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable quantitative data. Initial calibration demonstrates that the instrument is capable of acceptable performance in the beginning, and continuing calibration checks document satisfactory maintenance and adjustment of the instrument over specific time periods.

B. Criteria

1. Initial Calibration Linearity Check

The Percent Relative Standard Deviation (%RSD) of calibration factors for aldrin, endrin, DDT, and dibutylchlorendate must not exceed 10%. If toxaphene is identified and quantified, a three-point calibration is required. If the calibration factor for DDT or toxaphene is outside the 10% RSD window, calibration curves must be used for quantitation of DDT, DDE, DDD, or toxaphene.

$$\text{Calibration Factor} = \frac{\text{Total Area of Peak}}{\text{Mass Injected (ng)}}$$

$$\%RSD = \frac{\sigma}{CF} \times 100$$

where,

σ = Standard Deviation

CF = Mean Calibration Factor

Note: The 10% RSD linearity check is required only for columns which are used for quantitative determinations. Quantitation of the surrogate requires the use of a column shown to meet the 10% linearity criterion. Columns used only to provide qualitative confirmation are not required to meet this criterion.

2. Analytical Sequence

a. Primary Analysis

At the beginning of each 72-hour period all standards must be analyzed.

b. Confirmation Analysis

1) Evaluation Standard Mix A, B, and C are required for the curve.

2) Only the standards containing the compound(s) to be confirmed are required. These standards must be repeated after every five samples.

3) Evaluation Mix B is required after every ten samples.

3. Continuing Calibration

The calibration factor for each standard must be within 15% of the standard at the beginning of the analytical sequence on quantitation columns (20% on confirmation columns).

C. Evaluation Procedure

1. Initial Calibration

a. Inspect the Pesticide Evaluation Standards Summary (Form VIII) and verify agreement with the raw GC data (chromatograms and data system printouts).

b. Check the raw data and recalculate some of the calibration factors and the percent relative standard deviations (%RSD) for aldrin, endrin, 4,4'-DDT, and dibutylchlorendate at the three calibration concentrations.

c. Verify that the %RSD for the calibration factor of each specific pesticide is less than or equal to 10% for each 72-hour period.

d. If errors are detected, more comprehensive recalculation should be performed.

e. If toxaphene or the DDT series was identified and quantitated, verify that a three-point calibration was established.

2. Verify that all standards were analyzed in the 72-hour sequence.

3. Continuing Calibration

a. Review the pesticide sample data to verify whether the standard was used as a quantitation standard or as a confirmation standard.

b. For the quantitation standards, check the raw data to verify the percent difference (%D), using the following formula, for approximately ten percent of the reported values by recalculation.

$$\%D = \frac{R_1 - R_2}{R_1} \times 100$$

where,

R_1 = Calibration Factor from first analysis

R_2 = Calibration Factor from subsequent analysis

D. Action

1. Initial Calibration

If criteria for linearity are not met, flag all associated quantitative results as estimated (J).

2. Analytical Sequence

If the proper standards have not been analyzed, data may be affected. The data reviewer must use professional judgment to determine severity of the effect and qualify the data accordingly.

3. Continuing Calibration

a. If the %D between calibration factors is greater than 15% for the compound(s) being quantitated (20% for compounds being confirmed), flag all associated positive quantitative results as estimated (J).

IV. BLANKS

A. Objective

The assessment of blank analysis results is to determine the existence and magnitude of contamination problems. The criteria for evaluation of blanks apply to any blank associated with the samples. If problems with any blank exist, all data associated with the Case must be carefully evaluated to determine whether or not there is an inherent variability in the data for the Case, or the problem is an isolated occurrence not affecting other data.

B. Criteria

No contaminants should be present in the blank(s).

C. Evaluation Procedure

1. Review the results of all associated blank(s), Form I(s) and raw data (chromatograms, quantitation reports or data system printouts).

2. Verify that the method blank analysis(es) contains less than the Contract Required Quantitation Limits (CRQL) of any Pesticide/PCB or interfering peak.

3. Verify that method blank analysis has been reported per matrix, per concentration level, for each GC system used to analyze samples, and for each extraction batch.

D. Action

Action in the case of unsuitable blank results depends on the circumstances and the origin of the blank. No positive sample results should be reported unless the concentration of the compound in the sample exceeds 5 times the amount in the blank. In instances where more than one blank is associated with a given sample, qualification should be based upon a comparison with the associated blank having the highest concentration of a contaminant. The results must not be corrected by subtracting the blank value. Specific actions are as follows:

1. If a Pesticide/PCB is found in the blank but not found in the sample(s), no action is taken.

2. Any Pesticide/PCB detected in the sample and also detected in any associated blank, must be qualified when the sample concentration is less than 5 times the blank concentration.

   The reviewer should note that the blank analyses may not involve the same weights, volumes or dilution factors as the associated samples. These factors must be taken into consideration when applying the 5x criteria, such that a comparison of the total amount of contamination is actually made.

   Additionally, there may be instances where little or no contamination was present in the associated blanks, but qualification of the sample was deemed

necessary. Contamination introduced through dilution water is one example. Although it is not always possible to determine, instances of this occurring can be detected when contaminants are found in the diluted sample result, but absent in the undiluted sample result. Since both results are not routinely reported, it may be impossible to verify this source of contamination. However, if the reviewer determines that the contamination is from a source other than the sample, he/she should qualify the data. In this case, the 5x rule does not apply; the sample value should be reported as a non-detect.

3. The following are examples of applying the blank qualification guidelines. Certain circumstances may warrant deviations from these guidelines.

Case 1: Sample result is greater than the CRQL, but is less than the required amount (5x) from the blank result.

	5x
Blank Result	1.0
CRQL	.5
Sample Result	4.0
Qualified Sample Result	4.0U

In this case, sample results less than 5.0 (or 5 x 1.0) would be qualified as non-detects.

Case 2: Sample result is greater than the required amount (5x) from the blank result.

	5x
Blank Result	1.0
CRQL	.5
Sample Result	6.0
Qualified Sample Result	6.0

V. SURROGATE RECOVERY

A. Objective

Laboratory performance on individual samples is established by means of spiking activities. All samples are spiked with a surrogate compound prior to sample preparation. The evaluation of the results of these surrogate spikes is not necessarily straightforward. The sample itself may produce effects due to such factors as interferences and high concentrations of analytes. Since the effects of the sample matrix are frequently outside the control of the laboratory and may present relatively unique problems, the review and validation of data based on specific sample results is frequently subjective and demands analytical experience and professional judgment. Accordingly, this section consists primarily of guidelines, in some cases with several optional approaches suggested.

B. Criteria

Sample and blank recoveries of dibutylchlorendate must be within limits as per applicable SOW (Form II).

C. Evaluation Procedure

1. Check raw data (i.e., chromatograms, quant list, etc.) to verify the recoveries on the Surrogate Recovery (Form II).

2. If recoveries are not within limits, check raw data for possible interferences which may have affected surrogate recoveries.

D. Action

If pesticide surrogate recoveries are outside of advisory windows, the following guidance is suggested:

1. If low recoveries are obtained, flag associated positive results and quantitation limits as estimated (J).

2. If high recoveries are obtained, professional judgment should be used to determine appropriate action. A high bias may be due to co-eluting interferences.

3. If zero pesticide surrogate recovery is reported, the reviewer should examine the sample chromatogram to determine if the surrogate may be present, but slightly outside its retention time window. If this is the case, in addition to assessing surrogate recovery for quantitative bias, the overriding consideration is to investigate the qualitative validity of the analysis. If the surrogate is not present, flag all negative results as unusable (R).

VI. MATRIX SPIKE/MATRIX SPIKE DUPLICATE

A. Objective

These data are generated to determine long-term precision and accuracy of the analytical method on various matrices. These data alone cannot be used to evaluate the precision and accuracy of individual samples.

B. Criteria

1. Advisory limits are established for spike recovery limits in the appropriate SOW and on Form III.

2. Advisory limits are established for relative percent difference between matrix spike and matrix spike duplicate recoveries in the appropriate SOW and on Form III.

C. Evaluation Procedure

1. Inspect results for the Matrix Spike/Matrix Spike Duplicate Recovery (Form III).

2. Verify transcriptions from raw data and verify calculations.

D. Action

No action is taken on Matrix Spike/Matrix Spike Duplicate (MS/MSD) data alone to qualify an entire Case. However, using informed professional judgment, the data reviewer may use the matrix spike and matrix spike duplicate results in conjunction with other QC criteria and determine the need for some qualification of the data.

The data reviewer should first try to determine to what extent the results of the MS/MSD affect the associated data. This determination should be made with regard to the MS/MSD sample itself as well as specific analytes for all samples associated with the MS/MSD.

In those instances where it can be determined that the results of the MS/MSD affect only the sample spiked, then qualification should be limited to this sample alone. However, it may be determined through the MS/MSD results that a lab is having a systematic problem in the analysis of one or more analytes, which affects all associated samples.

VII. FIELD DUPLICATES

A. Objective

Field duplicate samples may be taken and analyzed as an indication of overall precision. These analyses measure both field and lab precision; therefore, the results may have more variability than lab duplicates which measure only lab performance. It is also expected that soil duplicate results will have a greater variance than water matrices due to difficulties associated with collecting identical field samples.

B. Criteria

There are no specific review criteria for field duplicate analyses comparability.

C. Evaluation Procedures

Samples which are field duplicates should be identified using EPA Sample Traffic Reports or sample field sheets. The reviewer should compare the results reported for each sample and calculate the Relative Percent Difference (RPD).

D. Action

Any evaluation of the field duplicates should be provided with the reviewer's comments.

VIII. COMPOUND IDENTIFICATION

A. Objective

Qualitative criteria for compound identification have been established to minimize the number of erroneous identifications of compounds. An erroneous identification can either be a false positive (reporting a compound present when it is not) or a false negative (not reporting a compound that is present).

B. Criteria

1. Retention times of reported compounds must fall within the calculated retention time windows for the two chromatographic columns.

2. GC/MS confirmation is required if the concentration of a compound exceeds 10 ng/uL in the final sample extract.

C. Evaluation Procedure

1. Review Form I, the associated raw data (chromatograms and data system printouts) and the Pesticide/PCB Identification Summary (Form X). Confirm reported positive detects, using appropriate retention times and retention time windows, and verify that the compounds listed as "not detected" are correct.

2. Verify that positive identifications have dissimilar column analysis. (The 3% OV-1 column cannot be used for confirmation if both dieldrin and DDE are identified.)

3. For multipeak pesticides (chlordane and toxaphene) and PCBs, the retention times and relative peak height ratios of major component peaks should be compared against the appropriate standard chromatograms.

4 Verify that GC/MS confirmation was performed for pesticides/PCB concentrations in the final sample extract which exceeded 10 ng/uL.

D. Action

1. If the qualitative criteria for two-column confirmation were not met, all reported positive detects should be considered non-detects. The reviewer should use professional judgment to assign an appropriate quantitation limit using the following guidance:

   a. If the misidentified peak was sufficiently outside the target pesticide retention time window, then the CRQL can be reported.

   b. If the misidentified peak poses an interference with potential detection of a target peak, then the reported value should be considered and flagged as the estimated quantitation limit (UJ).

2. If PCBs or multipeak pesticides exhibit marginal pattern-matching quality, professional judgment should be used to establish whether the differences are attributable to environmental "weathering". If the presence of a

PCB/multipeak pesticide is strongly suggested, results should be reported as presumptively present (N).

If an observed pattern closely matches more than one Aroclor, professional judgment should be used to decide whether the neighboring Aroclor is a better match, or if multiple Aroclors are present.

3. If GC/MS confirmation was required but not performed, the reviewer should notify the DPO.

IX. COMPOUND QUANTITATION AND REPORTED DETECTION LIMITS

A. Objective

The objective is to ensure that the reported quantitation results and CRQLs are accurate.

B. Criteria

Compound quantitation, as well as the adjustment of the CRQL, must be calculated according to the appropriate SOW.

C. Evaluation Procedure

1. Raw data should be examined to verify the correct calculation of all sample results reported by the laboratory. Quantitation reports, chromatograms, and sample preparation log sheets should be compared to the reported positive sample results and quantitation limits.

2. Verify that the CRQLs have been adjusted to reflect all sample dilutions, concentrations, splits, clean-up activities, and dry weight factors that are not accounted for by the method.

D. Action

Quantitation limits affected by large, off-scale peaks should be flagged as unusable (R). If the interference is on-scale, the reviewer can provide an estimated quantitation limit (UJ) for each affected compound.

Note: Simple-peak pesticide results can be checked for rough agreement between quantitative results obtained on the two GC columns. The reviewer should use professional judgment to decide whether a much larger concentration obtained on one column versus the other indicates the presence of an interfering compound. If an interfering compound is indicated, the lower of the two values should be reported and qualified as presumptively present at an estimated quantity (NJ). This necessitates a determination of an estimated concentration on the confirmation column. The narrative should indicate that the presence of interferences has obscured the attempt at a second column confirmation.

X. OVERALL ASSESSMENT OF DATA FOR A CASE

It is appropriate for the data reviewer to make professional judgments and express concerns and comments on the validity of the overall data package for a Case. This is particularly appropriate for Cases in which there are several QC criteria out of specification. The additive nature of QC factors out of specification is difficult to assess in an objective manner, but the reviewer has a responsibility to inform users concerning data quality and data limitations in order to assist that user in avoiding inappropriate use of the data, while not precluding any consideration of the data at all. The data reviewer would be greatly assisted in this endeavor if the data quality objectives were provided.

GLOSSARY A

Data Qualifier Definitions

For the purposes of this document the following code letters and associated definitions are provided.

U - The material was analyzed for, but was not detected. The associated numerical value is the sample quantitation limit.

J - The associated numerical value is an estimated quantity.

R - The data are unusable (compound may or may not be present). Resampling and reanalysis is necessary for verification.

N - Presumptive evidence of presence of material.

NJ - Presumptive evidence of the presence of the material at an estimated quantity.

UJ - The material was analyzed for, but was not detected. The sample quantitation limit is an estimated quantity.

The reviewer may determine that qualifiers other than those used in this document are necessary to describe or qualify the data. In these instances, it is the responsibility of each Region to thoroughly document/explain the qualifiers used.

GLOSSARY B

Other Terms

BFB	Bromofluorobenzene — volatile tuning compound
BNA	Base/Neutral/Acid Compounds — compounds analyzed by semivolatile technique
Case	A finite, usually predetermined number of samples collected over a given time period for a particular site. A case consists of one or more Sample Delivery Group(s).
CCC	Calibration Check Compound
CCS	Contract Compliance Screening - process in which SMO inspects analytical data for contractual compliance and provides results to the Regions, laboratories and EMSL/LV.
CF	Calibration Factor
CRQL	Contract Required Quantitation Limit
DFTPP	Decafluorotriphenylphosphine — semivolatile tuning compound
DPO	Deputy Project Officer
EICP	Extracted Ion Current Profile
GC/EC	Gas Chromatography/Electron Capture Detector
GC/MS	Gas Chromatograph/Mass Spectrometer
GPC	Gel Permeation Chromatography - A sample clean-up technique that separates compounds by size and molecular weight. Generally used to remove oily materials from sample extracts.
IS	Internal Standards - Compounds added to every VOA and BNA standard, blank, matrix spike duplicate, and sample extract at a known concentration, prior to instrumental analysis. Internal standards are used as the basis for quantitation of the target compounds.
MS/MSD	Matrix Spike/Matrix Spike Duplicate
m/z	The ratio of mass (m) to charge (z) of ions measured by GC/MS
OADS	Organic Analysis Data Sheet (Form I)
ORDA	Organic Regional Data Assessment
PCB	Polychlorinated biphenyl

PE Sample	Performance Evaluation Sample
Primary Analysis	One of two types of pesticide/PCB analysis by GC/EC techniques, the other being confirmation analysis. If the two analyses are run at separate times, the primary analysis is the first analysis chronologically, and is used to establish the tentative identification of any pesticides/PCBs detected. The identification is then confirmed in the confirmation analysis. If the two analyses are done simultaneously, either may be considered the primary analysis. Either may be used for quantitation if contract criteria are met.
QA	Quality Assurance - Total program for assuring the reliability of data.
QC	Quality Control - Routine application of procedures for controlling the monitoring process.
RIC	Reconstructed Ion Chromatogram
RPD	Relative Percent Difference (between matrix spike and matrix spike duplicate)
RRF	Relative Response Factor
$\overline{RRF}$	Average Relative Response Factor
RRT	Relative Retention Time (with relation to internal standard)
RSD	Relative Standard Deviation
RT	Retention Time
SDG	Sample Delivery Group - Defined by one of the following, whichever occurs first o Case of field samples o Each 20 field samples within a Case o Each 14-day calendar period during which field samples in a Case are received, beginning with receipt of the first sample in the SDG. (For VOA contracts, the calendar period is 7-day.)
SMO	Sample Management Office
SOP	Standard Operating Procedure
SOW	Statement of Work
SPCC	System Performance Check Compound
SV	Semivolatile analysis - Method based on analysis by GC/MS for BNA organic compounds.
TCL	Target Compound List
TIC	Tentatively Identified Compound - A compound not on the TCL.

VOA	Volatile Organic Analysis - Method based on the purge and trap technique for organic compound analysis.
VTSR	Validated Time of Sample Receipt — Time of sample receipt at the laboratory as recorded on the shipper's delivery receipt and Sample Traffic Report.
σ	Standard Deviation Estimate (of a sample)

Region _____

ORGANIC REGIONAL DATA ASSESSMENT

CASE NO. _____ SITE _____

LABORATORY _____ NO. OF SAMPLES/ MATRIX _____

SDG #_____ REVIEWER (IF NOT ESD) _____

SOW#_____ REVIEWER'S NAME_____

DPO: ACTION _____ FYI _____ COMPLETION DATE _____

DATA ASSESSMENT SUMMARY

		VOA	BNA	PEST	OTHER
1.	HOLDING TIMES				
2.	GC/MS TUNE/INSTR. PERFORM.				
3.	CALIBRATIONS				
4.	BLANKS				
5.	SURROGATES				
6.	MATRIX SPIKE/DUP				
7.	OTHER QC				
8.	INTERNAL STANDARDS				
9.	COMPOUND IDENTIFICATION				
10.	SYSTEM PERFORMANCE				
11.	OVERALL ASSESSMENT				

O = Data had no problems/or qualified due to minor problems.
M = Data qualified due to major problems.
Z = Data unacceptable.
X = Problems, but do not affect data.

ACTION ITEMS: _____

_____

_____

AREAS OF CONCERN: _____

_____

_____

NOTABLE PERFORMANCE:_____

_____

_____

LABORATORY DATA VALIDATION

FUNCTIONAL GUIDELINES FOR EVALUATING INORGANICS ANALYSES

Prepared for the

HAZARDOUS SITE EVALUATION DIVISION
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July 1, 1988

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INTRODUCTION

This document is designed to offer guidance in laboratory data evaluation and validation. In some aspects, it is equivalent to a Standard Operating Procedure (SOP). In other, more subjective areas, only general guidance is offered due to the complexities and uniqueness of data relative to specific samples. These Guidelines have been updated to include all requirements in the 7/87 Statement of Work (SOW) for Inorganics, Amendment 1 and December 1987 Revisions.

Those areas where specific SOPs are possible are primarily areas in which definitive performance requirements are established. These requirements are concerned with specifications that are not sample dependent; they specify performance requirements on matters that should be fully under a laboratory's control. These specific areas include blanks, calibration standards, calibration verification standards, laboratory control standards, and interference check standards. In particular, mistakes such as calculation and transcription errors must be rectified by resubmission of corrected data sheets.

This document is intended for technical review. Some areas of overlap between technical review and Contract Compliance Screening (CCS) exist; however, determining contract compliance is not intended to be a goal of these guidelines. It is assumed that the CCS is available and can be utilized to assist in the data review procedure.

At times, there may be an urgent need to use data which do not meet all contract requirements and technical criteria. Use of these data does <u>not</u> constitute either a new requirement standard or full acceptance of the data. Any decision to utilize data for which performance criteria have not been met is strictly to facilitate the progress of projects requiring the availability of the data. A contract laboratory submitting data which are out of specification may be required to rerun or resubmit data even if the previously submitted data have been utilized due to urgent program needs; data which do not meet specified requirements are never fully acceptable. The only exception to this requirement is in the area of requirements for individual sample analysis; if the nature of the sample itself limits the attainment of specifications, appropriate allowances must be made. The overriding concern of the Agency is to obtain data which are technically valid and legally defensible.

All data reviews must have, as a cover sheet, the Inorganic Regional Data Assessment (IRDA) form. (A copy is attached at the end of this document.) If mandatory actions are required, they should be specifically noted on this form. In addition, this form is to be used to summarize overall deficiencies requiring attention, as well as general laboratory performance and any discernible trends in the quality of the data. (This form is not a replacement for the data review.) Sufficient supplementary documentation must accompany the form to clearly identify the problems associated with a Case. The form and any attachments must be submitted to the Contract Laboratory Program Quality Assurance Coordinator (CLP QAC), the Regional Deputy Project Officer (DPO), and the Environmental Monitoring Systems Laboratory in Las Vegas (EMSL/LV).

It is the responsibility of the data reviewer to notify the Regional DPO concerning problems and shortcomings with regard to laboratory data. If there is an urgent requirement, the DPO may be contacted by telephone to expedite corrective action. It is recommended that all items for DPO action be presented at one time. In any case, the Inorganic Regional Data Assessment form must be completed and submitted.

PRELIMINARY REVIEW

In order to use this document effectively, the reviewer should have a general overview of the Case at hand. The exact number of samples, their assigned numbers, their matrix, and the number of laboratories involved in their analysis are essential information. Background information on the site is helpful but often this information is very difficult to locate. The site project officer is the best source for answers or further direction.

CCS is a source of a large quantity of summarized information. It can be used to alert the reviewer of problems in the Case or what may be sample-specific problems. This information may be utilized in data validation. If CCS is unavailable, those criteria affecting data validity must be addressed by the data reviewer.

Cases routinely have unique samples which require special attention by the reviewer. Field blanks, field duplicates, and performance audit samples need to be identified. The sampling records should provide:

1. Project Officer for site
2. Complete list of samples with notations on
   a) sample matrix
   b) blanks*
   c) field duplicates*
   d) field spikes*
   e) QC audit sample*
   f) shipping dates
   g) labs involved

* If applicable

The chain-of-custody record includes sample descriptions and date of sam[illegible] Although sampling date is not addressed by contract requirements, the reviewer mus[illegible] into account lag time between sampling and shipping while assessing sample holding times.

INORGANICS PROCEDURE

The requirements to be checked in validation are listed below. ("CCS" indicates that the contractual requirements for these items will also be checked by CCS; CCS requirements are not always the same as the data review criteria.)

I. Holding Times (CCS - Lab holding times only)

II. Calibration

- o Initial (CCS)
- o Initial and Continuing Calibration Verification (CCS)

III. Blanks (CCS)

IV. ICP Interference Check Sample (CCS)

V. Laboratory Control Sample (CCS)

VI. Duplicate Sample (CCS)

VII. Matrix Spike Sample (CCS)

VIII. Furnace Atomic Absorption QC (CCS)

IX. ICP Serial Dilution (CCS)

X. Sample Result Verification (CCS - 10%)

XI. Field Duplicates

XII. Overall Assessment of Data for a Case

I. HOLDING TIMES

A. Objective

The objective is to ascertain the validity of results based on the holding time of the sample from time of collection to time of analysis.

Note: The holding time is based on the date of collection, rather than verified time of sample receipt, and date of digestion/distillation. It is a technical evaluation rather than a contractual requirement.

B. Criteria

Technical requirements for sample holding times have only been established for water matrices. The following holding time and preservation requirements were established under 40 CFR 136 (Clean Water Act) and are found in Volume 49, Number 209 of the Federal Register, page 43260, issued on October 26, 1984.

METALS:	6 months; preserved to pH < 2
MERCURY:	28 days; preserved to pH < 2
CYANIDE:	14 days; preserved to pH > 12

C. Evaluation Procedure

Actual holding times are established by comparing the sampling date on the EP Sample Traffic Report with the dates of analysis found in the laboratory raw da (digestion logs and instrument run logs). Examine the digestion and/or distillati logs to determine if samples were preserved at the proper pH.

Analyte Holding Time (Days) = Analysis Date - Sampling Date

D. Action

1. If 40 CFR 136 criteria for holding times and preservation are not met, qualify all results > Instrument Detection Limit (IDL) as estimated (J) and results < IDL as estimated (UJ).

2. If holding times are exceeded, the reviewer must use professional judgment to determine the reliability of the data and the effects of additional storage on the sample results. The expected bias would be low and the reviewer may determine that results < IDL are unusable (R).

3. Due to limited information concerning holding times for soil samples, it is left to the discretion of the data reviewer whether to apply water holding time criteria to soil samples. If the data are qualified when water holding time criteria are applied to soil samples, it must be clearly documented in the review.

II. CALIBRATION

A. Objective

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable quantitative data. Initial calibration demonstrates that the instrument is capable of acceptable performance at the beginning of the analysis run, and continuing calibration verification documents that the initial calibration is still valid.

B. Criteria

1. Initial Calibration

Instruments must be calibrated daily and each time the instrument is set up.

a. ICP Analysis

A blank and at least one standard must be used in establishing the analytical curve.

b. Atomic Absorption Analysis (AA)

1) A blank and at least three standards, one of which must be at the Contract Required Detection Limit (CRDL), must be used in establishing the analytical curve.

2) The correlation coefficient must be $\geq$0.995.

Note: The correlation coefficient of 0.995 is a technical criterion and not contractual.

c. Mercury Analysis

1) A blank and at least four standards must be used in establishing the analytical curve.

2) The correlation coefficient must be $\geq$0.995.

d. Cyanide Analysis

1) A blank and at least three standards must be used in establishing the analytical curve.

2) A midrange standard must be distilled.

3) A correlation coefficient $\geq$0.995 is required for photometric determination.

2. Initial and Continuing Calibration Verification (ICV and CCV)

a. Analysis results must fall within the control limits of 90 -110 percent Recovery (%R) of the true value for all analytes except mercury and cyanide.

b. Analysis results for mercury must fall within the control limits of 80-120%R.

c. Analysis results for cyanide must fall within the control limits of 85-115%R.

C. Evaluation Procedure

1. Verify that the instrument was calibrated daily and each time the instrument was set up using the correct number of standards and blank.

2. Verify that the correlation coefficient is $\geq$0.995

3. Check the distillation log and verify that the midrange CN standard was distilled.

4. Recalculate one or more of the ICV and CCV %R per type of analysis (ICP, GFAA, etc.) using the following equation and verify that the recalculated value agrees with the laboratory reported values on Form IIA. Due to possible rounding discrepancies, allow results to fall within 1% of the contract windows (e.g., 89-111%).

$$\%R = \frac{\text{Found}}{\text{True}} \times 100$$

Where,

Found = concentration (in ug/L) of each analyte measured in the analysis of the ICV or CCV solution

True = concentration (in ug/L) of each analyte in the ICV or CCV source

D. Action

1. If the minimum number of standards as defined in section B were not used for initial calibration, or if the instrument was not calibrated daily and each time the instrument was set up, qualify the data as unusable (R).

2. If the correlation coefficient is <0.995, qualify results > IDL as estimated (J), and results < IDL as estimated (UJ).

Note: For critical samples, further evaluation of the calibration curve may be warranted to determine if qualification is necessary.

3. If the midrange CN standard was not distilled, qualify all associated results as estimated (J).

4. If the ICV or CCV %R falls outside the acceptance windows, use professional judgment to qualify all associated data. If possible, indicate the bias in the review. The following guidelines are recommended:

   a. If the ICV or CCV %R falls outside the acceptance windows but within the ranges of 75-89% or 111-125% (CN, 70-84% or 116-130%; Hg, 65-79% or 121-135%), qualify results > IDL as estimated (J).

   b. If the ICV or CCV %R is within the range of 111-125% (CN, 116-130%, Hg, 121-135%), results < IDL are acceptable.

   c. If the ICV or CCV %R is 75-89% (CN, 70-84%; Hg, 65-79%), qualify results < IDL as estimated (UJ).

   d. If the ICV or CCV %R is <75%, (CN, <70%; Hg, <65%), qualify all positive results as unusable (R).

   e. If the ICV or CCV %R is >125%, (CN >130%; Hg >135%), qualify results > IDL as unusable (R); results < IDL are acceptable.

III. BLANKS

A. Objective

The assessment of blank analysis results is to determine the existence and magnitude of contamination problems. The criteria for evaluation of blanks applies to any blank associated with the samples. If problems with any blank exist, all data associated with the Case must be carefully evaluated to determine whether or not there is an inherent variability in the data for the Case, or if the problem is an isolated occurrence not affecting other data.

B. Criteria

No contaminants should be in the blank(s).

C. Evaluation Procedures

Review the results reported on the Blank Summary (Form III) as well as the raw data (ICP printouts, strip charts, printer tapes, bench sheets, etc.) for all blanks and verify that the results were accurately reported.

D. Action

Action in the case of unsuitable blank results depends on the circumstances and origin of the blank. Sample results > IDL but <5 times the amount in any blank should be qualified as (U).

Any blank with a negative result whose absolute value is > IDL must be carefully evaluated to determine its effect on the sample data.

Note: The blank analyses may not involve the same weights, volumes, or dilution factors as the associated samples. In particular, soil sample results reported on Form I will not be on the same basis (units, dilution) as the calibration blank data reported on Form III. The reviewer may find it easier to work from the raw data when applying 5X criteria to soil sample data/calibration blank data.

In instances where more than one blank is associated with a given sample, qualification should be based upon a comparison with the associated blank having the highest concentration of a contaminant. The results must not be corrected by subtracting any blank value.

IV. ICP INTERFERENCE CHECK SAMPLE (ICS)

A. Objective

The ICP Interference Check Sample verifies the contract laboratory's interelement and background correction factors.

B. Criteria

1. An ICS must be run at the beginning and end of each sample analysis run (or a minimum of twice per 8 hour working shift, whichever is more frequent).

2. Results for the ICS solution AB analysis must fall within the control limits of ± 20% of the true value.

C. Evaluation Procedure

1. Recalculate from the raw data (ICP printout) one or more of the recoveries using the following equation (%R) and verify that the recalculated value agrees with the laboratory reported values on Form IV.

$$\text{ICS \%R} = \frac{\text{Found Solution AB}}{\text{True Solution AB}} \times 100$$

Where,

Found Solution AB = concentration (in ug/L) of each analyte measured in the analysis of solution AB

True Solution AB = concentration (in ug/L) of each analyte in solution AB

2. Check ICS raw data for results with an absolute value > IDL for those analytes which are not present in the ICS solution.

D. Action

1. For samples with concentrations of Al, Ca, Fe, and Mg which are comparable to or greater than their respective levels in the Interference Check Sample:

   a. If the ICS recovery for an element is >120% and the sample results are < IDL, this data is acceptable for use.

   b. If the ICS recovery for an element is >120% and the sample results are > IDL, qualify the affected data as estimated (J).

   c. If the ICS recovery for an element falls between 50 and 79% and the sample results are > IDL, qualify the affected data as estimated (J).

   d. If sample results are < IDL, and the ICS recovery for that analyte falls within the range of 50-79%, the possibility of false negatives may exist. Qualify the data for these samples as estimated (UJ).

   e. If ICS recovery results for an element fall <50%, qualify the affected data as unusable (R).

   Note: If possible, indicate the bias for the estimated results in the review.

2. If results > IDL are observed for elements which are not present in the EPA provided ICS solution, the possibility of false positives exists. An evaluation of the associated sample data for the affected elements should be made. For samples with comparable or higher levels of interferents and with analyte concentrations that approximate those levels found in the ICS (false positives), qualify sample results > IDL as estimated (J).

3. If negative results are observed for elements that are not present in the EPA ICS solutions, and their absolute value is > IDL, the possibility of false negatives in the samples may exist. If the absolute value of the negative results is > IDL, an evaluation of the associated sample data should be made. For samples with comparable or higher levels of interferents, qualify results for the affected analytes < IDL as estimated (UJ).

4. In general, the sample data can be accepted if the concentrations of Al, Ca, Fe and Mg in the sample are found to be less than or equal to their respective concentrations in the ICS. If these elements are present at concentrations greater than the level in the ICS, or other elements are present in the sample at >10 mg/L, the reviewer should investigate the possibility of other interference effects by using Table 2 given on page D-22 of the 7/87 SOW. These analyte concentration equivalents presented in the Table should

considered only as estimated values, since the exact value of any analytical system is instrument specific. Therefore, estimate the concentration produced by an interfering element. If the estimate is >2X CRDL and also greater than 10% of the reported concentration of the affected element, qualify the affected results as estimated (J).

V. LABORATORY CONTROL SAMPLE (LCS)

A. Objective

The laboratory control sample serves as a monitor of the overall performance of all steps in the analysis, including the sample preparation.

B. Criteria

1. All aqueous LCS results must fall within the control limits of 80-120%R, except Sb and Ag which have no control limits.

2. All solid LCS results must fall within the control limits established by the EPA. This information is available from EMSL/LV.

C. Evaluation Procedure

1. Review Form VII and verify that results fall within the control limits.

2. Check the raw data (ICP printout, strip charts, bench sheets) to verify the reported recoveries on Form VII. Recalculate one or more of the recoveries (%R) using the following equation:

$$\text{LCS \%R} = \frac{\text{LCS Found}}{\text{LCS True}} \times 100$$

Where,

LCS Found = concentration (in ug/L for aqueous; mg/kg for solid) of each analyte measured in the analysis of LCS solution

LCS True = concentration (in ug/L for aqueous; mg/kg for solid) of each analyte in the LCS source

D. Action

1. Aqueous LCS

a. If the LCS recovery for any analyte falls within the range of 50 - 79% or >120%, qualify results > IDL as estimated (J).

b. If results are < IDL and the LCS recovery is greater than 120%, the data are acceptable.

c. If results are < IDL and the LCS recovery falls within the range of 50-79%, qualify the data for the affected analytes as estimated (UJ).

d. If LCS recovery results are <50%, qualify the data for these samples as unusable (R).

2. Solid LCS

a. If the solid LCS recovery for any analyte falls outside the EPA control limits, qualify all sample results > IDL as estimated (J).

b. If the LCS results are higher than the control limits and the sample results are < IDL, the data are acceptable.

c. If the LCS results are lower than the control limits, qualify all sample results < IDL as estimated (UJ).

VI. DUPLICATE SAMPLE ANALYSIS

A. Objective

Duplicate analyses are indicators of laboratory precision based on each sample matrix.

B. Criteria

1. Samples identified as field blanks cannot be used for duplicate sample analysis.

2. A control limit of ± 20% (35% for soil) for the Relative Percent Difference (RPD) shall be used for sample values >5X CRDL.

3. A control limit of ±CRDL (±2X CRDL for soil) shall be used for sample values <5X CRDL, including the case when only one of the duplicate sample values is <5X CRDL.

C. Evaluation Procedure

1. Review Form VI and verify that results fall within the control limits.

2. Check the raw data and recalculate one or more RPD using the following equation to verify that results have been correctly reported on Form VI.

$$RPD = \frac{|S-D|}{(S+D)/2} \times 100$$

Where,

S = First Sample Value (original)
D = Second Sample Value (duplicate)

3. Verify that the field blank was not used for duplicate analysis.

D. Action

1. If duplicate analysis results for a particular analyte fall outside the appropriate control windows, qualify the results for that analyte in all associated samples of the same matrix as estimated (J).

2. If the field blank was used for duplicate analysis, all other QC data must be carefully checked and professional judgment exercised when evaluating the data.

Note: This information must be included on the IRDA form.

VII. MATRIX SPIKE SAMPLE ANALYSIS

A. Objective

The matrix spike sample analysis provides information about the effect of each sample matrix on the digestion and measurement methodology.

B. Criteria

1. Samples identified as field blanks cannot be used for spiked sample analysis.

2. Spike recovery (%R) must be within the limits of 75-125%. However, spike recovery limits do not apply when sample concentration exceeds the spike concentration by a factor of 4 or more.

C. Evaluation Procedure

1. Review Form V and verify that results fall within the specified limits.

2. Check raw data and recalculate one or more %R using the following equation to verify that results were correctly reported on Form V.

$$\%R = \frac{(SSR-SR)}{SA} \times 100$$

Where,

SSR = Spiked Sample Result
SR = Sample Result
SA = Spike Added

3. Verify that the field blank was not used for spike analysis.

D. Action

1. If the spike recovery is >125% and the reported sample results are < IDL, the data is acceptable for use.

2. If the spike recovery is >125% or <75% and the sample results are > IDL, qualify the data for these samples as estimated (J).

3. If the spike recovery falls within the range of 30-74% and the sample results are < IDL, qualify the data for these samples as estimated (UJ).

4. If spike recovery results fall <30% and the sample results are < IDL, qualify the data for these samples as unusable (R).

5. If the field blank was used for matrix spike analysis, all other QC data must be carefully checked and professional judgment exercised when evaluating the data.

Note: This information must be included on the IRDA form.

Note: If the matrix spike recovery does not meet criteria (except in Ag), a post digestion spike is required for all methods except furnace, but this data is not used to qualify sample results. However, this information must be included in the IRDA report.

VIII. FURNACE ATOMIC ABSORPTION QC

A. Objective

Duplicate injections and furnace post digestion spikes establish the precision and accuracy of the individual analytical determinations.

B. Criteria

1. For sample concentrations > CRDL, duplicate injections must agree within ±20% Relative Standard Deviation (RSD), (or Coefficient of Variation (CV)), otherwise the sample must be rerun once (at least two additional injections).

2. Spike recovery must be ≥85% and ≤115%.

3. The Furnace Atomic Absorption Scheme must be followed as described in the 7/87 SOW, p. E-15.

C. Evaluation Procedure

1. Check raw data to verify that duplicate injections agree within ±20% RSD (or CV) for sample concentrations > CRDL.

2. Review Furnace AA raw data to verify that the Furnace Atomic Absorption Scheme has been followed.

D. Action

1. If duplicate injections are outside the ±20% RSD (or CV) limits and the sample has not been rerun once as required, qualify the data as estimated (J).

2. If the rerun sample results do not agree within ±20% RSD (or CV), qualify the data as estimated (J).

3. If the post digestion spike recovery is <40%, qualify results > IDL as estimated (J).

4. If the post digestion spike recovery is ≥10%, but <40%, qualify results < IDL as estimated (UJ).

5. If the post digestion spike recovery is <10%, qualify results < IDL as unusable (R).

6. If sample absorbance is <50% of the post digestion spike absorbance then:

   a. If the furnace post digestion spike recovery is not within 85-115%, qualify the sample results > IDL as estimated (J).

   b. If the furnace post digestion spike recovery is not within 85-115%, qualify the sample results < IDL as estimated (UJ).

7. If Method of Standard Additions (MSA) is required but has not been done, qualify the data as estimated (J).

8. If any of the samples run by MSA have not been spiked at the appropriate levels, qualify the data as estimated (J).

9. If the MSA correlation coefficient is <0.995, qualify the data as estimated (J).

IX. ICP SERIAL DILUTION

A. Objective

The serial dilution determines whether significant physical or chemical interferences exist due to sample matrix.

B. Criteria

If the analyte concentration is sufficiently high (concentration in the original sample is minimally a factor of 50 above the IDL), an analysis of a 5-fold dilution must agree within 10% Difference (%D) of the original results.

C. Evaluation Procedures

1. Check the raw data and recalculate the %D using the following equation to verify that the dilution analysis results agree with results reported on Form IX.

$$\%D = \frac{|I-S|}{I} \times 100$$

Where,

I = Initial Sample Result
S = Serial Dilution Result (Instrument Reading x 5)

2. Check the raw data for evidence of negative interference, i.e., results of the diluted sample are significantly higher than the original sample.

D. Action

1. When criteria are not met, qualify the associated data as estimated (J).

2. If evidence of negative interference is found, use professional judgment to qualify the data.

X. SAMPLE RESULT VERIFICATION

A. Objective

The objective is to ensure that the reported quantitation results are accurate.

B. Criteria

Analyte quantitation must be calculated according to the appropriate SOW.

C. Evaluation Procedures

The raw data should be examined to verify the correct calculation of sample results reported by the laboratory. Digestion and distillation logs, instrument printouts, strip charts, etc. should be compared to the reported sample results.

1. Examine the raw data for any anomalies (i.e., baseline shifts, negative absorbances, omissions, legibility, etc.).

2. Verify that there are no transcription or reduction errors (e.g., dilutions, percent solids, sample weights) on one or more samples.

3. Verify that results fall within the linear range of the ICP (Form XIII) and within the calibrated range for the non-ICP parameters.

4. Verify that sample results are >5X ICP IDL, if ICP analysis results are used for As, Tl, Se, or Pb.

Note: When the laboratory provides both ICP and furnace results for an analyte in a sample and the concentration is > ICP IDL, the results can assist in identifying quantitation problems.

D. Action

If there are any discrepancies found, the laboratory may be contacted by the designated representative to obtain additional information that could resolve any differences. If a discrepancy remains unresolved, the reviewer may determine qualification of the data is warranted.

XI. FIELD DUPLICATES

A. Objective

Field duplicate samples may be taken and analyzed as an indication of overall precision. These analyses measure both field and lab precision; therefore, the results may have more variability than lab duplicates which measure only lab performance. It is also expected that soil duplicate results will have a greater variance than water matrices due to difficulties associated with collecting identical field samples.

B. Criteria

There are no review criteria for field duplicate analyses comparability.

C. Evaluation Procedures

Samples which are field duplicates should be identified using EPA Sample Traffic Reports or sample field sheets. The reviewer should compare the results reported for each sample and calculate the Relative Percent Difference (RPD), if appropriate.

D. Action

Any evaluation of the field duplicates should be provided with the reviewer's comments.

XII. OVERALL ASSESSMENT OF DATA FOR A CASE

It is appropriate for the data reviewer to make professional judgments and express concerns and comments on the validity of the overall data for a Case. This is particularly appropriate when there are several QC criteria out of specification. The additive nature of QC factors out of specification is difficult to assess in an objective manner, but the reviewer has a responsibility to inform the user concerning data quality and data limitations in order to assist that user in avoiding inappropriate use of the data, while not precluding any consideration of the data at all. If qualifiers other than those used in this document are necessary to describe or qualify the data, it is necessary to thoroughly document/explain the additional qualifiers used. The data reviewer would be greatly assisted in this endeavor if the data quality objectives were provided. The cover form and supplementary documentation must be included with the review.

GLOSSARY A

Data Qualifier Definitions

For the purposes of this document the following code letters and associated definitions are provided.

U - The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

J - The associated value is an estimated quantity.

R - The data are unusable. (Note: Analyte may or may not be present.)

UJ - The material was analyzed for, but was not detected. The associated value is an estimate and may be inaccurate or imprecise.

GLOSSARY B

Additional Terms

Associated Samples	Any sample related to a particular QC analysis. For example: - For ICV, all samples run under the same calibration curve. - For duplicate RPD, all SDG samples digested/distilled of the same matrix.
AA	Atomic Absorption
Calibration Curve	A plot of absorbance versus concentration of standards
Case	A finite, usually predetermined number of samples collected in a given time period for a particular site. A Case consists of one or more Sample Delivery Groups.
CCB	Continuing Calibration Blank - a deionized water sample run every ten samples designed to detect any carryover contamination.
CCS	Contract Compliance Screening - process in which SMO inspects analytical data for contractual compliance and provides EMSL/LV, laboratories, and the Regions with their findings.
CCV	Continuing Calibration Verification - a standard run every ten samples designed to test instrument performance.
CLP	Contract Laboratory Program
CRDL	Contract Required Detection Limit
CV	Coefficient of Variation
DPO	Deputy Project Officer
EMSL/LV	Environmental Monitoring System Laboratory/ Las Vegas (P.O. Box 15027, Las Vegas, Nevada 89114)
Field Blank	Field blanks are intended to identify contaminants that may have been introduced in the field. Examples are trip blanks, travel blanks, rinsate blanks, and decontamination blanks.

Field Duplicate	A duplicate sample generated in the field, not in the laboratory.
Holding Time	The time from sample collection to laboratory analysis.
ICB	Initial Calibration Blank - first blank standard run to confirm the calibration curve.
ICP	Inductively Coupled Plasma
ICS	Interference Check Sample
ICV	Initial Calibration Verification - first standard run to confirm the calibration curve.
Initial Calibration	The establishment of a calibration curve with the appropriate number of standards and concentration range. The calibration curve plots absorbance or emission versus concentration of standards.
IRDA	Inorganic Regional Data Assessment
LCS	Laboratory Control Sample - supplied by EPA
MS	Matrix Spike - introduction of a known concentration of analyte into a sample to provide information about the effect of the sample matrix on the digestion and measurement methodology.
MSA	Method of Standard Addition
Post digestion Spike	The addition of a known amount of standard after digestion. (Also identified as analytical spike, or spike, for furnace analyses.)
QAC	Quality Assurance Coordinator
RPD	Relative Percent Difference
RSCC	Regional Sample Control Center
RSD	Relative Standard Deviation
Serial Dilution	A sample run at a specific dilution to determine whether any significant chemical or physical interferences exist due to sample matrix effects. (ICP only)

SDG	Sample Delivery Group - defined by one of the following, whichever occurs first: - case of field samples - each twenty field samples in a Case - each 14-day calendar period during which field samples in a Case are received, beginning with receipt of the first sample in the SDG.
SMO	Sample Management Office
SOP	Standard Operating Procedure
SOW	Statement of Work

Region _____

INORGANIC REGIONAL DATA ASSESSMENT

CASE NO. _____ SITE _____

LABORATORY _____ NO. OF SAMPLES/ MATRIX _____

SDG#_____ REVIEWER (IF NOT ESD) _____

SOW#_____ REVIEWER'S NAME _____

DPO: ACTION _____ FYI _____ COMPLETION DATE _____

DATA ASSESSMENT SUMMARY

		ICP	AA	Hg	CYANIDE
1.	HOLDING TIMES	_____	_____	_____	_____
2.	CALIBRATIONS	_____	_____	_____	_____
3.	BLANKS	_____	_____	_____	_____
4.	ICS	_____			
5.	LCS	_____	_____		
6.	DUPLICATE ANALYSIS	_____	_____	_____	_____
7.	MATRIX SPIKE	_____	_____	_____	_____
8.	MSA		_____		
9.	SERIAL DILUTION	_____			
10.	SAMPLE VERIFICATION	_____	_____	_____	_____
11.	OTHER QC	_____	_____	_____	_____
12.	OVERALL ASSESSMENT	_____	_____	_____	_____

O = Data had no problems/or qualified due to minor problems.
M = Data qualified due to major problems.
Z = Data unacceptable.
X = Problems, but do not affect data.

ACTION ITEMS: _____

_____

_____

AREAS OF CONCERN: _____

_____

_____

NOTABLE PERFORMANCE: _____

_____

_____

LEVEL C DATA VALIDATION GUIDELINES

LEVEL C DATA VALIDATION GUIDELINES

Listed below are the validation criteria which will be utilized in evaluating the analytical data for a Level C QC site. Note: All holding times will be evaluated from the date/time of sample collection, not from the validated date/time of sample receipt by the laboratory.

1. For Petroleum Hydrocarbons (418.1/SW-3540, EPA 418.1)

   Holding Times - Holding times are 28 days for water samples which are preserved and refrigerated. No holding times are cited for soils.

   Calibration - Ensure that a three-to-five point curve bracketing the sample concentration is performed daily.

   Blanks - A blank should be run with each batch. If the blank concentration exceeds the reporting limit, the reporting limit shall be raised and the data flagged as estimated (UJ).

2. Target-Compound List (TCL) for VOAs (CLP Methods)

   Holding Times - Samples must be analyzed within the holding times specified in Sect. 3 or the data should be marked as estimated (J)>

   GC/MS Tuning - Check that bromofluorobenzene tune is completed each 23-h shift of operation. Check that it meets the CLP criteria. Assure that each sample is associated with a tune.

   Initial Calibration - The maximum relative standard deviation [(RSD) percent RSD] shall not be >30% for indicted CLP CCC. The maximum mean relative response factor (RRF) for SPCC shall be >0.300 (0.250 for bromoform). The SPCCs are chloromethane,

1,1-dichloroethane, bromoform, 1,1,2,2-tetrachloroethane, and chlorobenzene. the CCC compounds are vinyl chloride, 1,1-dichloroethene, chloroform, 1,2-dichloropropane, toluene, and ethylbenzene.

Continuing Calibration - The minimum response factor for the SPCC components for VOAs analyses shall not be <0.300 (0.250 for bromoform). The maximum response factor percent deviation for indicated CLP CCC components from the mean initial calibration response factor shall not exceed 25%. If these criteria are exceeded, a new calibration for the compound shall be employed.

Blank/Spike Control Samples - Any control sample which exceeds the internal QC limits set by the laboratory for a given sample matrix shall require all data from the associated batch of samples to be closely inspected. If no analytical problems are found, the data analyzed with the out-of-control point shall be discussed in the QC section of MPR and final report. If problems are found in the analytical data, the samples associated with the batch shall be reanalyzed and the data from reanalysis reported. If holding times are exceeded in the reanalysis, both sets of data shall be presented.

If the blank/spike results are outside the internal laboratory limits and if the matrix spike results are outside the CLP limits, the laboratory will either reanalyze the samples within the holding times or the data will be flagged with an "R," and the data are not usable.

Surrogates - If surrogates exceed the CLP limits, the data shall be flagged that the surrogates exceeded limits.

Method Blanks - A method blank should be run each day following the Continuing Calibration STandard. Common

laboratory solvents should not be found in the blank at levels over five times the detection limits. Other compounds should not be found in the blank at levels exceeding the detection limits. If common contaminant compounds are detected in samples at a concentration of <10 times the concentration found in the blank, or other compounds at <5 times the concentration in the blank, report those compounds as not detected. Adjust the sample quantitation limit to the value reported in the samples and flag the limit as estimated (UJ).

Matrix Spike/Spike Duplicate - Ensure that 1 out of 20 samples has been spiked in duplicate. The recoveries shall meet the CLP criteria. If the recoveries do not meet the criteria, examine the blank spike data. If the blank spike data exceed the limits and the matrix spikes exceed limits, the data shall be flagged as unusable (R). If the blank spike data from the batch are satisfactory, the data is usable, and the low recovery is discussed in the final report QA/QC and in the QC report sent to the NCR.

Field Trip and Equipment Blanks - If contaminant analytes are detected in samples at concentrations of <5 times the concentration found in the highest associated blank, the results are considered suspect and are reported as estimated.

3. TCL Semivolatile Organics (CLP methods)

Holding Times - Samples must be extracted within 7 days of collection and analyzed within 40 days of extraction. Any samples which do not meet these requirements must be flagged as estimated.

GC/MS Tune - Make certain that a decafluorotriphenylphosphine tune is completed every 12 h of sample analysis, that each sample is associated with a tune, and that each tune meets CLP

requirements. Data are not reported if the instrument does not tune.

Initial Calibration - Ensure that a 5-point curve has been completed. The RRF of the BNA compounds shall be a minimum of 0.050 for the SPCC listed in the current revision of the CLP. The maximum RSD for the CCC listed in the CLP procedure is 30.0%. The minimum RRF for the SPCC is 0.050, and the maximum percent difference for the CCC is 25%. If these limits are exceeded, a new calibration curve shall be generated.

Continuing Calibration - The continuing calibration check will be performed once every 12 h during operation. The minimum RRF for the SPCC is 0.05, and the maximum percent difference from the initial calibration shall not exceed 25% for the CCC. If these limits are exceeded, a new calibration curve shall be generated.

Blank/Spike Control Samples - Any control sample which exceeds the internal QC limits set by the laboratory for a given sample matrix shall require all data from the associated batch of samples to be closely inspected. If no analytical problems are found, the data and the out-of-control point shall be discussed in the QC section of the report. If problems are found in the analytical data, the samples associated with the batch shall be reanalyzed and the data from reanalysis reported. If holding times are exceeded in the reanalysis, both sets of data shall be presented.

If the blank/spike results are outside the internal laboratory limits and if the matrix spike results are outside the CLP limits, the laboratory will either reanalyze the samples or the data will be flagged with an "R", and the data is not usable.

Surrogates - If surrogates exceed the CLP limits, the data shall be flagged that the surrogates exceeded limits.

Blanks - A method blank should be run each day following the Continuing Calibration Standard. Phthalate should not be found in the blank at levels over five times the detection limits. Other compounds should not be found in the blank at levels exceeding the detection limits. If common contaminant compounds are detected in samples at a concentration of <10 times the concentration found in the blank, or other compounds at <5 times the concentration in the blank, report those compounds as not detected. Adjust the sample quantitation limit to the value reported in the samples and flag the limit as estimated (UJ).

Matrix Spike/Spike Duplicate - ensure that 1 out of 20 samples has been spiked in duplicate. The recoveries should meet the CLP criteria. If the recoveries do not meet the criteria, examine the blank spike data. If the blank spike data exceed the limits and the matrix spikes exceed limits, the data shall be flagged as unusable (R). If the blanks spike data from the batch is satisfactory, the data are usable, and the low recovery is discussed in the final QC report sent to the Analytical Environmental Support Section.

4. Metals

Holding Times - Samples must be analyzed within six months, except mercury shall be analyzed in 28 days from sample collection.

ICP Initial Calibration - A calibration blank and at least one standard must be analyzed daily. An initial calibration verification standard must be within 90 to 110% recovery or

the samples should be reanalyzed. If it is not possible to perform reanalysis, the data are rejected and flagged with an "R."

AA Calibration - Calibration blank and at least three standards shall be used in establishing the curve prior to sample analysis. A curve shall be analyzed each day prior to sample analysis.

Calibration Verification - Verification using a standard obtained from a source other than that of the initial calibration shall be used and the result shall be within 90 to 110% of the true value for both ICP and AA work. Calibration verification shall be done at a minimum frequency of 10% of every 2 h, whichever is more frequent, and shall be done at the end of the analytical run.

Method Blanks - At least one preparation blank shall be prepared with each batch of samples. The blanks shall contain less than the detection limit for all analytes. If the concentration of the associated blanks is above the detection limit and if the lowest analyte concentration is <10 times the blank, reanalysis of the sample must occur. If reanalysis is not done, the data shall be reported and flagged as estimated. The blank shall never be subtracted from the sample.

Field and Equipment Blanks - If contaminant analytes are detected in samples at concentrations of <5 times the concentration found int eh highest associated blank, the results are considered suspect and are reported as estimated.

Blank/Spike Laboratory Control Samples - Any laboratory control sample which exceeds the internal QC limits set by the laboratory for a given sample matrix shall require all data from the associated batch of samples to be closely inspected.

If no analytical problems are found, the data and out-of-control point shall be discussed in the QC section of the report. If problems are found in the analytical data, the samples associated with the batch shall be reanalyzed and the data from reanalysis reported. If holding times are exceeded in the reanalysis, both sets of data shall be presented. A discussion of data reported when the blank/spike laboratory control sample is out of control shall be presented in the QC section of both the final report and the MPR.

If the blank/spike results are outside the internal laboratory limits and if the matrix spike results are outside the CLP limits, the laboratory will either reanalyze the samples or the data will be flagged with an "R," and the data are not usable.

5. Wet Chemistry

Sample Preservation - A review of field sampling logs and chain-of-custody forms will be performed to insure samples were properly preserved in accordance with requirements defined in Table 1 of the QAPP.

Holding Times - A review of sample collection, preparation, and analysis times will be performed. All samples must be prepared and/or analyzed within the holding times specified in Table 1 of the QAPP. Samples exceeding holding time that are reported as non-detected will be flagged "R" as unusable. Samples exceeding holding times that have reported concentrations of analytes above the detection limit will be flagged "J" as qualitative.

Calibration - Ensure that at least a three-to-five point curve bracketing the sample concentration is performed daily. This applies to all methods unless the method specifically calls

for single point calibrations. Results reported without proper calibration may be considered unacceptable. Compare percent RSD or percent difference from initial calibrations, if appropriate.

Detection Limits - Ensure detection limits in method blanks are low enough to meet the established ARAR. If dilutions of samples were made which have resulted in elevations of the detection limits, ensure that the dilution is appropriate (needed) and that the recovered value was still within the working range of the instrument calibration. Samples that have unexplained high detection limits above the targeted (required) limits that are reported as below detection limits should be flagged "R" as unusable.

Method Blanks - All blanks should be free of the compounds of interest being recovered by this method. If contaminants are present at values above the detection limits the 5 Time Rule for evaluation of blanks specified in the EPA Data Validation Functional Guidelines for Inorganics Analyses should be applied. Data should be flagged in accordance with this guideline.

Blank (Reagent Water) Spikes - A review of the reported results and control charts should be conducted. Values outside of the established control limits should be flagged based on the criteria presented in Section 12.5 of the QAPP. Guidance in applying the correct qualifier code may be obtained by following the procedure defined in the EPA Laboratory Data Validation Functional Guidelines for Inorganics Analyses for Laboratory Control Samples.

Matrix Spike/Matrix Spike Duplicates - A review of matrix spike and matrix spike duplicate data should be performed. Values reported should be evaluated in accordance with the

guidelines established for matrix spikes and matrix spike duplicates in the EPA Laboratory Data Validation Functional Guidelines for Inorganics Analyses.

Laboratory Duplicates - Laboratory duplicates, if performed, should be evaluated in accordance with the procedures specified for Duplicates in the EPA Laboratory Data Validation Function Guidelines for Inorganics Analysis.

06\REPORTS\NASJAX.DVG

FIELD DATA VALIDATION CHECKLIST

1-88
CWA/F-1

Project Name: _____
Project Number: _____
Sample Identification: _____
_____
Sampling Team: _____
Analyzing Laboratory: _____
Analyses Performed: _____
Sample Matrix: _____
QA Reporting Level: _____

REPORTING REQUIREMENTS

FIELD DATA PACKAGE DOCUMENTATION	YES	NO	NOT REQUIRED
1. Field (water and soil) sample logs completed properly and signed	____	____	____
2. Sampling dates noted	____	____	____
3. Sampling team indicated	____	____	____
4. Sample identification traceable to location collected	____	____	____
5. Sample location provided	____	____	____
6. Sample depth for soils indicated	____	____	____
7. Collection technique (bailer, pump etc)	____	____	____
8. Field preparation techniques and sample type indicated (grab, composite)	____	____	____
9. Sample container type described	____	____	____
10. Sample container type proper for analysis requested	____	____	____
11. Preservation methods indicated	____	____	____
12. Chain of custody form completed	____	____	____
13. Proper analytical methods requested	____	____	____
14. Proper number and type of field QC samples were collected (blanks, replicates, splits, etc.)	____	____	____
15. Field equipment was properly calibrated before use and results documented.	____	____	____

Comments: _____
_____

Field Documentation is complete: _____
QA Officer

MASTER SAMPLE LIST AND HOLDING TIME ANALYSIS

Parameters (Method): ____________________

SAMPLE ID NO.	COC NO.	PARAMETERS	SAMPLE COLLECTION DATE	SAMPLE PREPARATION DATE	SAMPLE ANALYSIS DATE	ALLOWABLE HOLD TIME	ACTUAL HOLD TIME	EXCEEDENCE TIME

DATA VALIDATION SUMMARY

PROJECT DESCRIPTION: _____

SITE NAME & LOCATION: _____

SAMPLE GROUP: _____

DATE COLLECTED: _____

QC REQUIREMENTS:	Furnace ICP	Furnace AA	Flame CV	Flame AA	MSA	CN
1 - Holding Times	___	___	___	___	___	___
2 - Intial & Cont. Calib. Verif.	___	___	___	___	___	___
3 - Calib. Curve Stds	___	___	___	___	___	___
4 - Method Blanks	___	___	___	___	___	___
5 - Field Blanks	___	___	___	___	___	___
6 - ICP ICS	___	N	N	N	N	N
7 - LCS	___	___	___	___	___	___
8 - Lab Duplicates	___	___	___	___	___	___
9 - Matrix Spike	___	___	___	___	___	___
10 - Furnace AA QC	N	___	N	N	___	N
11 - ICP Ser. Dilutions	___	N	N	N	N	N
12 - Result Verfication	___	___	___	___	___	___
13 - Field Duplicates	___	___	___	___	___	___

QC CRITERIA:

A - Acceptable: All criteria met.

P - Provisional: All criteria not met, data of reasonable quality, data useable.

U - Unacceptable: Criteria not met, data unusable

N - Not Applicable.

FIELD DUPLICATES

PROJECT DESCRIPTION: _____

SITE NAME & LOCATION: _____

SAMPLE GROUP: _____

DATE COLLECTED: _____

PARAMETERS:

ICP_____	Furnace AA_____
CV_____	Flame AA_____
MSA_____	Cyanide_____

QC CRITERIA: *

A - Acceptable:	Relative Percent Difference (RPDs) are within QC limits; (Suggested ±50 RPD).
P - Provisional:	Some RPDs are outside QC limits.
U - Unacceptable:	All RPDs are outside QC limits.
N - Not Applicable.	

REMARKS:

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* No specific review criteria to evaluate field duplicate comparability. Attachments: RPD calculations;
RPD = [(SR - DR)/((SR + DR)/2)] x 100

SAMPLE RESULT VERIFICATION

PROJECT DESCRIPTION: _____

SITE NAME & LOCATION: _____

SAMPLE GROUP: _____

DATE COLLECTED: _____

PARAMETERS:

ICP_____ Furnace AA_____

CV_____ Flame AA_____

MSA_____ Cyanide_____

QC CRITERIA: *

A - Acceptable: All criteria met.

P - Provisional: All criteria not met, data of reasonable quality, data useable.

U - Unacceptable: Criteria not met, data unusable

N - Not Applicable.

REMARKS:

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* Attachments: Review raw data package

ICP SERIAL DILUTIONS

PROJECT DESCRIPTION: _____

SITE NAME & LOCATION: _____

SAMPLE GROUP: _____

DATE COLLECTED: _____

PARAMETERS:

ICP_____	Furnace AA N
CV N	Flame AA N
MSA N	Cyanide N

QC CRITERIA: *

A - Acceptable: All criteria met.

P - Provisional: All criteria not met, data of reasonable quality, data useable.

U - Unacceptable: Criteria not met, data unusable

N - Not Applicable.

REMARKS:

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* Attachments: Form IX (ICP) and review raw data

FURNACE AA QC

PROJECT DESCRIPTION: _____

SITE NAME & LOCATION: _____

SAMPLE GROUP: _____

DATE COLLECTED: _____

PARAMETERS:

ICP N	Furnace AA_____
CV N	Flame AA N
MSA_____	Cyanide N

QC CRITERIA: *

A - Acceptable: All criteria met.

P - Provisional: All criteria not met, data of reasonable quality, data useable.

U - Unacceptable: Criteria not met, data unusable

N - Not Applicable.

REMARKS:

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* Attachments: Review raw data package

MATRIX SPIKE

PROJECT DESCRIPTION: _____

SITE NAME & LOCATION: _____

SAMPLE GROUP: _____

DATE COLLECTED: _____

PARAMETERS:

ICP_____	Furnace AA_____
CV_____	Flame AA_____
MSA_____	Cyanide_____

QC CRITERIA: *

A - Acceptable:	All %R within QC limits (75-125%) or meet CLP criteria or >125%R and reported sample result is <IDL.
P - Provisional:	Some %R not within QC limits (see guidance for appropriate qualifier flags).
U - Unacceptable:	%R <30% and sample results are reported as <IDL
N - Not Applicable.	

REMARKS: _____

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* Attachments: Form V (All Parameters)

LABORATORY DUPLICATES

PROJECT DESCRIPTION: _____

SITE NAME & LOCATION: _____

SAMPLE GROUP: _____

DATE COLLECTED: _____

PARAMETERS:

ICP_____	Furnace AA_____
CV_____	Flame AA_____
MSA_____	Cyanide_____

QC CRITERIA: *

A - Acceptable:	All relative percent differences (RPDs) are within QC limits.
P - Provisional:	Some RPDs outside of QC limits; field blank used for duplicate analysis.
U - Unacceptable:	All RPDs outside QC limits.
N - Not Applicable.	

REMARKS:

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* Attachments: Form VI (All Parameters)

LABORATORY CONTROL SAMPLES (LCS)

PROJECT DESCRIPTION: _____

SITE NAME & LOCATION: _____

SAMPLE GROUP: _____

DATE COLLECTED: _____

PARAMETERS:

ICP_____	Furnace AA_____
CV_____	Flame AA_____
MSA_____	Cyanide_____

QC CRITERIA: *

A - Acceptable:	All %R within QC limits or CLP criteria.
P - Provisional:	Some outside QC limits but %R not <50% or >120%.
U - Unacceptable:	If LCS falls less than 10%, indicative of severe laboratory or method deficiencies.
N - Not Applicable:	LCS are not required; LCS are used to evaluate method/sample preparation; analysis does not require preparation.

REMARKS:

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* Attachments: Form VII (All Parameters)

GC/MS TUNING AND PERFORMANCE

PROJECT DESCRIPTION: _____

SITE NAME & LOCATION: _____

SAMPLE GROUP: _____

DATE COLLECTED: _____

PARAMETERS:

VOCs_____

BNAs_____

PEST/PCBs N

QC CRITERIA: *

A - Acceptable:	All criteria met, spectra of good quality; Form V present for each 12-hour period.
P - Provisional:	All criteria not met, spectra of reasonable quality, data useable.
U - Unacceptable:	Criteria not met, spectra of poor quality, data unusable
N - Not Applicable.	

REMARKS:

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* Attachments: Form V (VOCs & BNAs)

HOLDING TIMES

PROJECT DESCRIPTION: _____

SITE NAME & LOCATION: _____

SAMPLE GROUP: _____

DATE COLLECTED: _____

PARAMETERS:

VOCs _____

BNAs _____

PEST/PCBs _____

QC CRITERIA: *

A - Acceptable: All QAPP and 40 CFR 136 specified holding times met.

P - Provisional: Some QAPP and 40 CFR 136 specified holding times are met.

U - Unacceptable: All holding time exceeded.

N - Not Applicable.

REMARKS:

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* Attachments: Holding Time Table

GC/MS CALIBRATION

PROJECT DESCRIPTION: _____

SITE NAME & LOCATION: _____

SAMPLE GROUP: _____

DATE COLLECTED: _____

PARAMETERS:

Marked

VOCs_____

BNAs_____

PEST/PCBs N

QC CRITERIA: *

A - Acceptable: All criteria met.

P - Provisional: Some criteria met, data useable.

U - Unacceptable: Criteria not met, data unusable.

N - Not Applicable.

REMARKS:

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* Attachments: Form VI and VII (VOCs & BNAs)

PESTICIDE/PCB INSTRUMENT PERFORMANCE

PROJECT DESCRIPTION: _____

SITE NAME & LOCATION: _____

SAMPLE GROUP: _____

DATE COLLECTED: _____

PARAMETERS:

VOCs N

BNAs N

PEST/PCBs_____

QC CRITERIA: *

A - Acceptable: All criteria met.

P - Provisional: All criteria not met, data of reasonable quality, data useable.

U - Unacceptable: Criteria not met, data unusable

N - Not Applicable.

REMARKS:

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* Attachments: Form IX (Pest/PCBs) and Raw Data Package

METHOD BLANKS

PROJECT DESCRIPTION: _____

SITE NAME & LOCATION: _____

SAMPLE GROUP: _____

DATE COLLECTED: _____

PARAMETERS:

VOCs_____

BNAs_____

PEST/PCBs_____

QC CRITERIA: *

A - Acceptable: No evidence of contaminants above minimum detection limits, no interference with sample results, appropriate blank used for each GC/MS system, extraction method, and analytical system.

P - Provisional: Contaminants present, but minimal interference with sample results (use 5X or 10X guidelines).

U - Unacceptable: Gross contamination, too much interference to use data for certain compounds or for the entire fraction; appropriate blanks not analyzed.

N - Not Applicable.

REMARKS:

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* Attachments: Form IV (All Parameters) and Method Blank analyses

Pest/PCBs CALIBRATION

PROJECT DESCRIPTION: _____

SITE NAME & LOCATION: _____

SAMPLE GROUP: _____

DATE COLLECTED: _____

PARAMETERS:

VOCs N

BNAs N

PEST/PCBs_____

QC CRITERIA: *

A - Acceptable: All criteria met.

P - Provisional: Some criteria met, data useable.

U - Unacceptable: Criteria not met, data unusable.

N - Not Applicable.

REMARKS:

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* Attachments: Form VIII (Pest/PCBs)

TRIP BLANKS

PROJECT DESCRIPTION: _____

SITE NAME & LOCATION: _____

SAMPLE GROUP: _____

DATE COLLECTED: _____

PARAMETERS:

VOCs_____

BNAs_____

PEST/PCBs_____

QC CRITERIA: *

A - Acceptable:	No evidence of contaminants above minimum detection limit.
P - Provisional:	Contaminants present, but minimal interference with sample results (use 5X or 10X guidelines).
U - Unacceptable:	Gross contamination resulting in definite compromise to the sample data integrity.

N - Not Applicable.

REMARKS:

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* Attachments: Refer to data summary table

FIELD BLANKS

PROJECT DESCRIPTION: _____

SITE NAME & LOCATION: _____

SAMPLE GROUP: _____

DATE COLLECTED: _____

PARAMETERS:

VOCs_____

BNAs_____

PEST/PCBs_____

QC CRITERIA: *

A - Acceptable: No evidence of contaminants above minimum detection limit.

P - Provisional: Contaminants present, but minimal interferance with sample results (use 5X or 10X guidelines).

U - Unacceptable: Gross contamination in blanks indicating poor sampling technique, bottle contamination, air-borne contamination, preservative contamination, or improper handling. Data for batch invalid or suspect.

N -Not Applicable.

REMARKS:

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* Attachments: Refer to data summary table

MATRIX SPIKE/MATRIX SPIKE DUPLICATE

PROJECT DESCRIPTION: _____

SITE NAME & LOCATION: _____

SAMPLE GROUP: _____

DATE COLLECTED: _____

PARAMETERS:

VOCs____

BNAs_____

PEST/PCBs____

QC CRITERIA: *

A - Acceptable:	<10% of compounds outside criteria.
P - Provisional:	>10% but <50% of compounds outside criteria; field blank used for MS/MSD.
U - Unacceptable:	>50% of compounds outside criteria and/or >10% of compounds with recoveries of <10%.
N - Not Applicable.	

REMARKS:

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* No action taken on MS/MSD data alone to qualify entire data set.
Attachments: Form III (All Parameters)

SURROGATE RECOVERY

PROJECT DESCRIPTION: _____

SITE NAME & LOCATION: _____

SAMPLE GROUP: _____

DATE COLLECTED: _____

PARAMETERS:

VOCs_____

BNAs_____

PEST/PCBs_____

QC CRITERIA: *

A - Acceptable:	No VOCs surrogate recovery or one BNAs or Pest/PCB surrogate recovery out of QC limits and percent recovery (%R) >10%
P - Provisional:	No more than one VOCs surrogate recovery or two BNAs or Pest/PCB surrogate recovery out of QC limits and percent recovery (%R) >10%; or if any percent recovery <10% with results greater than CRQL.
U - Unacceptable:	Any percent recovery <10% with results less than CRQL.

N - Not Applicable.

REMARKS:

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* Attachments: Form II (All Parameters)

INTERNAL STANDARDS PERFORMANCE

PROJECT DESCRIPTION: _____

SITE NAME & LOCATION: _____

SAMPLE GROUP: _____

DATE COLLECTED: _____

PARAMETERS:

VOCs_____

BNAs_____

PEST/PCBs N

QC CRITERIA: *

A - Acceptable:	All IS area counts are within -50% or +100% of the associated standard and retention times do not vary more than ±30 seconds.
P - Provisional:	Some IS area counts are outside -50% or +100% of the associated standard or retention times vary more than ±30 seconds.
U - Unacceptable:	Extremely low area counts reported or false negatives/positives exist.
N - Not Applicable	

REMARKS:

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* Attachments: Form VIII (VOCs & BNAs)

FIELD DUPLICATES

PROJECT DESCRIPTION: _____

SITE NAME & LOCATION: _____

SAMPLE GROUP: _____

DATE COLLECTED: _____

PARAMETERS:

VOCs_____

BNAs_____

PEST/PCBs_____

QC CRITERIA: *

A - Acceptable:	Relative Percent Difference (RPD) are within QC limits; (Suggested ±50 RPD).
P - Provisional:	Some RPDs are outside QC limits.
U - Unacceptable:	All RPDs are outside QC limits.
N - Not Applicable.	

REMARKS:

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* No specific review criteria to evaluate field duplicate comparability. Attachments: RPD calculations;
RPD = [(SR - DR)/((SR + DR)/2)] x 100

COMPOUND QUANTITATION & REPORTED DETECTION LIMITS

PROJECT DESCRIPTION: _____

SITE NAME & LOCATION: _____

SAMPLE GROUP: _____

DATE COLLECTED: _____

PARAMETERS:

VOCs_____

BNAs_____

PEST/PCBs_____

QC CRITERIA: *

A - Acceptable:	All criteria met.
P - Provisional:	All criteria not met, data of reasonable quality, data useable.
U - Unacceptable:	Criteria not met, data unusable
N - Not Applicable.	

REMARKS:

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* Attachments: Review Raw Data Package

COMPOUND IDENTIFICATION

PROJECT DESCRIPTION: _____

SITE NAME & LOCATION: _____

SAMPLE GROUP: _____

DATE COLLECTED: _____

PARAMETERS:

VOCs_____

BNAs_____

PEST/PCBs_____

QC CRITERIA: *

A - Acceptable:	All criteria met
P - Provisional:	All criteria not met, data of reasonable quality, data useable.
U - Unacceptable:	Criteria not met, data unusable
N - Not Applicable.	

REMARKS:

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* Attachments: Review Raw Data Package

DATA VALIDATION SUMMARY

PROJECT DESCRIPTION: _____

SITE NAME & LOCATION: _____

SAMPLE GROUP: _____

DATE COLLECTED: _____

QC REQUIREMENTS:	VOCs	BNAs	PEST/PCBs
1 - Holding Times	____	____	____
2 - GC/MS Tuning & Performance	____	____	N
3 - Pest/PCBs Performance	N	N	____
4 - GC/MS Calibration	____	____	N
5 - Pest/PCBs Calibration	N	N	____
6 - Method Blanks	____	____	____
7 - Field Blanks	____	____	____
8 - Trip Blanks	____	____	____
9 - Surrogate Recovery	____	____	____
10 - MS/MSD	____	____	____
11 - Field Duplicates	____	____	____
12 - Internal Standards	____	____	N
13 - Compound Identification	____	____	____
14 - Quant & Detection Limits	____	____	____
15 - TICs	____	____	N

QC CRITERIA:

A - Acceptable: All criteria met.

P - Provisional: All criteria not met, data of reasonable quality, data useable.

U - Unacceptable: Criteria not met, data unusable

N - Not Applicable.

TENTATIVELY IDENTIFIED COMPOUNDS

PROJECT DESCRIPTION: _____

SITE NAME & LOCATION: _____

SAMPLE GROUP: _____

DATE COLLECTED: _____

PARAMETERS:

VOCs_____

BNAs_____

PEST/PCBs N

QC CRITERIA: *

A - Acceptable:	All criteria met.
P - Provisional:	All criteria not met, data of reasonable quality, data useable.
U - Unacceptable:	Criteria not met, data unusable
N - Not Applicable.	

REMARKS:

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* Attachments: Review Raw Data Package

INITIAL AND CONTINUING CALIBRATION VERIFICATION

PROJECT DESCRIPTION: _____

SITE NAME & LOCATION: _____

SAMPLE GROUP: _____

DATE COLLECTED: _____

PARAMETERS:

ICP_____	Furnace AA_____
CV_____	Flame AA_____
MSA_____	Cyanide_____

QC CRITERIA: *

A - Acceptable:	All criteria met and instrument calibrated daily.
P - Provisional:	All criteria not met, data of reasonable quality, data useable.
U - Unacceptable:	Criteria not met, data unusable
N - Not Applicable.	

REMARKS:

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* Attachments: Form IIA (All Parameters)

HOLDING TIMES

PROJECT DESCRIPTION: _____

SITE NAME & LOCATION: _____

SAMPLE GROUP: _____

DATE COLLECTED: _____

PARAMETERS:

ICP_____	Furnace AA_____
CV_____	Flame AA_____
MSA_____	Cyanide_____
CV Prep_____	Cyanide Prep_____

QC CRITERIA: *

A - Acceptable:	All QAPP and 40 CFR 136 specified holding times met.
P - Provisional:	Some QAPP and 40 CFR 136 specified holding times are met.
U - Unacceptable:	All holding time exceeded.
N - Not Applicable.	

REMARKS:

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* Attachments: Holding Time Table; Form X for Prep Holding Times

METHOD BLANKS

PROJECT DESCRIPTION: _____

SITE NAME & LOCATION: _____

SAMPLE GROUP: _____

DATE COLLECTED: _____

PARAMETERS:

ICP_____	Furnace AA_____
CV_____	Flame AA_____
MSA_____	Cyanide_____

QC CRITERIA: *

A - Acceptable:	No contaminants above IDL, no interference with sample results.
P - Provisional:	Contaminants present; sample results >IDL but <5 times the amount in any blank flagged with U.
U - Unacceptable:	Gross contamination, too much interference to use data or appropriate blanks not analyzed.
N - Not Applicable.	

REMARKS:

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* Attachments: Form III (All Parameters); Method Blank analyses

CALIBRATION CURVE STANDARDS

PROJECT DESCRIPTION: _____

SITE NAME & LOCATION: _____

SAMPLE GROUP: _____

DATE COLLECTED: _____

PARAMETERS:

ICP_____ Furnace AA_____

CV_____ Flame AA_____

MSA_____ Cyanide_____

QC CRITERIA: *

A - Acceptable: All curves three- to five-point curves with lowest standard at the LOQ; ICP - one point.

U - Unacceptable: Less than three-point curve and/or lowest standard not at the LOQ; no one-point verification for ICP.

N - Not Applicable.

REMARKS:

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* Attachments: Form III (All Parameters)

ICP INTERFERENCE CHECK SAMPLES (ICS)

PROJECT DESCRIPTION: _____

SITE NAME & LOCATION: _____

SAMPLE GROUP: _____

DATE COLLECTED: _____

PARAMETERS:

ICP_____	Furnace AA N
CV N	Flame AA N
MSA N	Cyanide N

QC CRITERIA: *

A - Acceptable: All results within ±20% of true value.

P - Provisional: All criteria not met; refer to guideline.

U - Unacceptable: Recovery results for an element <50%; data unusable.

N - Not Applicable.

REMARKS:

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* Attachments: Form IV (ICP)

FIELD BLANKS

PROJECT DESCRIPTION: _____

SITE NAME & LOCATION: _____

SAMPLE GROUP: _____

DATE COLLECTED: _____

PARAMETERS:

ICP_____	Furnace AA_____
CV_____	Flame AA_____
MSA_____	Cyanide_____

QC CRITERIA: *

A - Acceptable:	No contaminants above IDL, no interference with sample results.
P - Provisional:	Contaminants present; sample results >IDL but <5 times the amount in any blank flagged with U.
U - Unacceptable:	Gross contamination, too much interference to use data or appropriate blanks not analyzed.
N - Not Applicable.	

REMARKS:

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* Attachments: Refer to data summary table

LABORATORY DUPLICATES

PROJECT DESCRIPTION: _____

SITE NAME & LOCATION: _____

SAMPLE GROUP: _____

DATE COLLECTED: _____

PARAMETERS:

ICP_____	Furnace AA_____
CV_____	Flame AA_____
MSA_____	Cyanide_____

QC CRITERIA: *

A - Acceptable:	All relative percent differences (RPDs) are within QC limits.
P - Provisional:	Some RPDs outside of QC limits; field blank used for duplicate analysis.
U - Unacceptable:	All RPDs outside QC limits.
N - Not Applicable.	

REMARKS:

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* Attachments: Form VI (All Parameters)

LABORATORY CONTROL SAMPLES (LCS)

PROJECT DESCRIPTION: _____

SITE NAME & LOCATION: _____

SAMPLE GROUP: _____

DATE COLLECTED: _____

PARAMETERS:

ICP_____	Furnace AA_____
CV_____	Flame AA_____
MSA_____	Cyanide_____

QC CRITERIA: *

A - Acceptable:	All %R within QC limits or CLP criteria.
P - Provisional:	Some outside QC limits but %R not <50% or >120%.
U - Unacceptable:	If LCS falls less than 10%, indicative of severe laboratory or method deficiencies.
N - Not Applicable:	LCS are not required; LCS are used to evaluate method/sample preparation; analysis does not require preparation.

REMARKS:

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* Attachments: Form VII (All Parameters)

FURNACE AA QC

PROJECT DESCRIPTION: _____

SITE NAME & LOCATION: _____

SAMPLE GROUP: _____

DATE COLLECTED: _____

PARAMETERS:

ICP N	Furnace AA_____
CV N	Flame AA N
MSA_____	Cyanide N

QC CRITERIA: *

A - Acceptable: All criteria met.

P - Provisional: All criteria not met, data of reasonable quality, data useable.

U - Unacceptable: Criteria not met, data unusable

N - Not Applicable.

REMARKS:

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* Attachments: Review raw data package

MATRIX SPIKE

PROJECT DESCRIPTION: _____

SITE NAME & LOCATION: _____

SAMPLE GROUP: _____

DATE COLLECTED: _____

PARAMETERS:

ICP_____	Furnace AA_____
CV_____	Flame AA_____
MSA_____	Cyanide_____

QC CRITERIA: *

A - Acceptable:	All %R within QC limits (75-125%) or meet CLP criteria or >125%R and reported sample result is <IDL.
P - Provisional:	Some %R not within QC limits (see guidance for appropriate qualifier flags).
U - Unacceptable:	%R <30% and sample results are reported as <IDL
N - Not Applicable.	

REMARKS: _____

* Attachments: Form V (All Parameters)

SAMPLE RESULT VERIFICATION

PROJECT DESCRIPTION:_____

SITE NAME & LOCATION:_____

SAMPLE GROUP: _____

DATE COLLECTED: _____

PARAMETERS:

ICP_____	Furnace AA_____
CV_____	Flame AA_____
MSA_____	Cyanide_____

QC CRITERIA: *

A - Acceptable:	All criteria met.
P - Provisional:	All criteria not met, data of reasonable quality, data useable.
U - Unacceptable:	Criteria not met, data unusable
N - Not Applicable.	

REMARKS:

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* Attachments: Review raw data package

ICP SERIAL DILUTIONS

PROJECT DESCRIPTION: _____

SITE NAME & LOCATION: _____

SAMPLE GROUP: _____

DATE COLLECTED: _____

PARAMETERS:

ICP_____	Furnace AA N
CV N	Flame AA N
MSA N	Cyanide N

QC CRITERIA: *

A - Acceptable:	All criteria met.
P - Provisional:	All criteria not met, data of reasonable quality, data useable.
U - Unacceptable:	Criteria not met, data unusable
N - Not Applicable.	

REMARKS:

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* Attachments: Form IX (ICP) and review raw data

DATA VALIDATION SUMMARY

PROJECT DESCRIPTION: _____

SITE NAME & LOCATION: _____

SAMPLE GROUP: _____

DATE COLLECTED: _____

QC REQUIREMENTS:	ICP	Furnace AA	CV	Flame AA	MSA	CN
1 - Holding Times	___	___	___	___	___	___
2 - Intial & Cont. Calib. Verif.	___	___	___	___	___	___
3 - Calib. Curve Stds	___	___	___	___	___	___
4 - Method Blanks	___	___	___	___	___	___
5 - Field Blanks	___	___	___	___	___	___
6 - ICP ICS	___	N	N	N	N	N
7 - LCS	___	___	___	___	___	___
8 - Lab Duplicates	___	___	___	___	___	___
9 - Matrix Spike	___	___	___	___	___	___
10 - Furnace AA QC	N	___	N	N	___	N
11 - ICP Ser. Dilutions	___	N	N	N	N	N
12 - Result Verfication	___	___	___	___	___	___
13 - Field Duplicates	___	___	___	___	___	___

QC CRITERIA:

A - Acceptable: All criteria met.

P - Provisional: All criteria not met, data of reasonable quality, data useable.

U - Unacceptable: Criteria not met, data unusable

N - Not Applicable.

FIELD DUPLICATES

PROJECT DESCRIPTION: _____

SITE NAME & LOCATION: _____

SAMPLE GROUP: _____

DATE COLLECTED: _____

PARAMETERS:

ICP_____	Furnace AA_____
CV_____	Flame AA_____
MSA_____	Cyanide_____

QC CRITERIA: *

A - Acceptable:	Relative Percent Difference (RPDs) are within QC limits; (Suggested ±50 RPD).
P - Provisional:	Some RPDs are outside QC limits.
U - Unacceptable:	All RPDs are outside QC limits.
N - Not Applicable.	

REMARKS:

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* No specific review criteria to evaluate field duplicate comparability. Attachments: RPD calculations;
RPD = [(SR - DR)/((SR + DR)/2)] x 100

ATTACHMENT G

Contract Compliance Screen Checklist

CCS-QUALITY CONTROL REVIEW

INORGANICS DATA PACKAGE-METALS AND CYANIDE

Data Package Deliverable	Reported No	Reported Yes	Acceptable No	Acceptable Yes	Required No	Required Yes
1. Holding Times						
METALS	____	____	____	____	____	____
CYANIDE	____	____	____	____	____	____
WET CHEMISTRY	____	____	____	____	____	____
2. Calibration Curve Standards						
ICP	____	____	____	____	____	____
ATOMIC ABSORPTION	____	____	____	____	____	____
MERCURY	____	____	____	____	____	____
CYANIDE	____	____	____	____	____	____
WET CHEMISTRY	____	____	____	____	____	____
3. Initial Calibration Verification						
ICP	____	____	____	____	____	____
ATOMIC ABSORPTION	____	____	____	____	____	____
MERCURY	____	____	____	____	____	____
CYANIDE	____	____	____	____	____	____
WET CHEMISTRY	____	____	____	____	____	____
4. Continuing Calibration Verification						
ICP	____	____	____	____	____	____
ATOMIC ABSORPTION	____	____	____	____	____	____
MERCURY	____	____	____	____	____	____
CYANIDE	____	____	____	____	____	____
WET CHEMISTRY	____	____	____	____	____	____
5. Method Blanks						
ICP	____	____	____	____	____	____
ATOMIC ABSORPTION	____	____	____	____	____	____
MERCURY	____	____	____	____	____	____
CYANIDE	____	____	____	____	____	____
WET CHEMISTRY	____	____	____	____	____	____
6. Field Blanks						
ICP	____	____	____	____	____	____
ATOMIC ABSORPTION	____	____	____	____	____	____
MERCURY	____	____	____	____	____	____
CYANIDE	____	____	____	____	____	____
WET CHEMISTRY	____	____	____	____	____	____
7. ICP Interference Check Sample						
ICP	____	____	____	____	____	____
8. Laboratory Control Sample						
ICP	____	____	____	____	____	____
ATOMIC ABSORPTION	____	____	____	____	____	____
MERCURY	____	____	____	____	____	____
CYANIDE	____	____	____	____	____	____
WET CHEMISTRY	____	____	____	____	____	____

INORGANICS DATA PACKAGE-METALS AND CYANIDE

Data Package Deliverable	Reported No	Reported Yes	Acceptable No	Acceptable Yes	Required No	Required Yes
9. Laboratory Duplicates						
ICP	____	____	____	____	____	____
ATOMIC ABSORPTION	____	____	____	____	____	____
MERCURY	____	____	____	____	____	____
CYANIDE	____	____	____	____	____	____
WET CHEMISTRY	____	____	____	____	____	____
10. Matrix Spikes						
ICP	____	____	____	____	____	____
ATOMIC ABSORPTION	____	____	____	____	____	____
MERCURY	____	____	____	____	____	____
CYANIDE	____	____	____	____	____	____
WET CHEMISTRY	____	____	____	____	____	____
11. Furnace AA QC	____	____	____	____	____	____
12. ICP Serial Dilutions Check Sample						
ICP	____	____	____	____	____	____
13. Sample Result Verification						
ICP	____	____	____	____	____	____
14. Field Duplicates						
ICP	____	____	____	____	____	____
ATOMIC ABSORPTION	____	____	____	____	____	____
MERCURY	____	____	____	____	____	____
CYANIDE	____	____	____	____	____	____
WET CHEMISTRY	____	____	____	____	____	____

15. Summary:	Complete	Competent	Responsible
ICP	_____	_____	_____
ATOMIC ABSORPTION	_____	_____	_____
MERCURY	_____	_____	_____
CYANIDE	_____	_____	_____
WET CHEMISTRY	_____	_____	_____

CCS-QUALITY CONTROL REVIEW
INORGANICS DATA PACKAGE-METALS AND CYANIDE

Identified Data Package Discrepancies:

Data Validator /Date

Quality Assurance Officer/Date

CONTRACT COMPLIANCE SCREENING CHECKLIST

Project Name: _____ Date: _____
Project Number: _____ Sampling Date: _____
PSC Number: _____ Data Receipt Date: _____
QC Level: _____ Validation Date: _____
Sample Matrix: _____ No. of Samples: _____
Sample Identification: _____
_____
_____
Sample Matrix: _____
Sampling Team: _____
Analyzing Laboratory: _____
Analyses Performed: _____

GENERAL INFORMATION REVIEW

Data Package Deliverable	Reported		Acceptable		Required	
	No	Yes	No	Yes	No	Yes
1. Narrative Summary						
2. Sample Results						
3. Parameters						
4. Methods						
5. Detection limits						
6. Master Tracking list						
7. Sample Collect Date						
8. Lab. Received Date						
9. Prep/Extraction Date						
10. Sample Analysis Date						
11. Signed COC[1/]						

COMMENTS: _____

CCS-QUALITY CONTROL REVIEW
ORGANICS DATA PACKAGE

Data Package Deliverable	Reported No	Reported Yes	Acceptable No	Acceptable Yes	Required No	Required Yes
1. Holding Times						
VOAS						
BNAS						
PEST/PCBS						
OTHER						
2. GC Calibration Data						
Initial						
Continuing						
3. Calibration Factor						
4. Response Factor						
5. GC/MS Tuning (BFB)						
6. GC/MS Tuning (DFTPP)						
7. GC/MS Initial Calibration						
VOAS						
BNAS						
8. GC/MS Continuing Calibration						
VOAS						
BNAS						
9. Pesticides Instrument Performance						
DDT Retention Time						
Ret.Time Windows						
DDT/Endrin Deg. Ck.						
DBC Ret. Time Ck.						
10. Pesticides Calibration						
Init. Linearity Ck.						
Analytical Sequence						
Primary Analysis						
Confirm Analysis						
Continuing Calib						
11. Method Blanks						
VOAS						
BNAS						
PEST/PCBS						
OTHER						
12. Field Blanks						
VOAS						
BNAS						
PEST/PCBS						
OTHER						

Data Package Deliverable	Reported No	Reported Yes	Acceptable No	Acceptable Yes	Required No	Required Yes
13. Trip Blanks						
VOAS	____	____	____	____	____	____
14. Surrogate Recoveries						
VOAS	____	____	____	____	____	____
BNAS	____	____	____	____	____	____
PEST/PCBS	____	____	____	____	____	____
OTHER	____	____	____	____	____	____
15. Matrix Spike/Matrix Spike Duplicates						
VOAS	____	____	____	____	____	____
BNAS	____	____	____	____	____	____
PEST/PCBS	____	____	____	____	____	____
OTHER	____	____	____	____	____	____
16. Field Duplicates - WATER						
VOAS	____	____	____	____	____	____
BNAS	____	____	____	____	____	____
PEST/PCBS	____	____	____	____	____	____
OTHER	____	____	____	____	____	____
17. Field Duplicates - SOIL/SEDIMENT/SLUDGE/WASTE						
VOAS	____	____	____	____	____	____
BNAS	____	____	____	____	____	____
PEST/PCBS	____	____	____	____	____	____
OTHER	____	____	____	____	____	____
18. Internal Standards						
VOAS	____	____	____	____	____	____
BNAS	____	____	____	____	____	____
19. Compound Identifications						
VOAS	____	____	____	____	____	____
BNAS	____	____	____	____	____	____
PEST/PCBS	____	____	____	____	____	____
OTHER	____	____	____	____	____	____
20. Compound Quantitation and Reported Detection Limits						
VOAS	____	____	____	____	____	____
BNAS	____	____	____	____	____	____
PEST/PCBS	____	____	____	____	____	____
OTHER	____	____	____	____	____	____
21. Tentatively Identified Compounds						
VOAS	____	____	____	____	____	____
BNAS	____	____	____	____	____	____
PEST/PCBS	____	____	____	____	____	____
OTHER	____	____	____	____	____	____

CCS-QUALITY CONTROL REVIEW
ORGANICS DATA PACKAGE

Data Package Deliverable	Reported No	Reported Yes	Acceptable No	Acceptable Yes	Required No	Required Yes
22. Reagent Water (Blank) Spikes						
VOAS	____	____	____	____	____	____
BNAS	____	____	____	____	____	____
PEST/PCBS	____	____	____	____	____	____
OTHER	____	____	____	____	____	____
23. Reagent Water (Blank) Spike Duplicates						
VOAS	____	____	____	____	____	____
BNAS	____	____	____	____	____	____
PEST/PCBS	____	____	____	____	____	____
OTHER	____	____	____	____	____	____

24. Summary:	Complete	Competent	Responsible
VOAS	_____	_____	_____
BNAS	_____	_____	_____
PEST/PCBS	_____	_____	_____
OTHER	_____	_____	_____

Identified Data Package Discrepancies:

_____

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_____ _____

Data Validator /Date Quality Assurance Officer/Date

ATTACHMENT H

Data Validation Coding Form

ANALYTICAL DATA VALIDATION CHECKLIST

DATA VALIDATION CODING

Project Name: _____ Project Number: _____
QA Reporting Level: _____ Validation Date: _____

1. Qualifier Codes Assigned to Data: R, U, J, U/J, B, No flag

2. Identification of samples and parameters with codes:

	Sample ID	Parameters
R code		
B code		
U code		
J code		
U/J code		

Explanation: _____

VALIDATION PERFORMED BY: _____

SIGNED: _____

DATE: _____

DATA USABILITY CLASSIFICATION

NOTE: Use of this form is optional.

Project Name: _____ Project Number: _____
QA Reporting Level: _____ Validation Date: _____

Data class: Sample Matrix:	Level A	Level B	Unusable
SOIL			
SEDIMENT			
GROUND WATER			
SURFACE WATER			

Identity of samples and parameters that are in different use Levels:

Sample ID	Parameter	Qualifier Code	LEVELS A	B	Un. 1/

1/ Un. = unusable data

VALIDATION PERFORMED BY: _____

Signed: _____
QUALITY ASSURANCE OFFICER

Date : _____

APPENDIX 4.3

QA/QC REPORT PLAN
NAVAL AIR STATION - JACKSONVILLE
JACKSONVILLE, FLORIDA

CONTENTS

1.0 INTRODUCTION

The purpose of the Final Report QA/QC Plan is to provide a mechanism to evaluate the quality and completeness of the Final Product/Report to be submitted to the Navy. The Final Report will include the results of the investigation and documentation of decisions. The Final Product/Report QA/QC Plan is designed to accomplish several objectives: (1) to ensure the decision process has been appropriately documented and that project and data quality objectives specified in the Basic Site Work Plan and its components, including the Basic Sampling and Analysis Plan, the Quality Assurance Program Plan (QAPP), and the Basic Field Sampling Plan (BFSP) have been appropriately followed; (2) define the final report content and format (final investigation report format); and (3) establish review processes by which each component of the final report will be verified (review process checklist).

2.0 RI REPORT

To ensure that the decision process has been appropriately documented and that project and data quality objectives specified in the Basic Site Work Plan (and subsidiary documents) have been appropriately observed, the elements of the RI Report are described below. The Remedial Investigation Report Format Checklist presented in Section 8.0 will be referenced to ensure the major components identified below are included in the Final Report.

2.1 RI Report Introduction

The RI Report introduction will describe the purpose of the report, the tasks required to establish the background for the data collection and analysis activities, and a summary of tasks required

to characterize the selected OU. A brief discussion of each of the report components is presented below.

2.1.1 Purpose of the RI Report and OU Background

At a minimum this section of the RI report should specify the expected reasons the RI was required to be conducted. The OU background section of the report should include a discussion of the following:

1. Detailed OU Descriptions - for the OU studied including location, size, configuration, and existing structures, etc.;

2. Detailed OU History - including facility type, past and current activities and operations, types of chemicals, wastes, products, or other materials stored, manufactured or lost on the OU, planned future use, community perceptions, descriptions of surrounding community, population physiography records, demographic records, census records, regional and site maps, topography, OU ownership, etc.; and

3. Results From Previous OU Investigations - including both physical and chemical data, Regulatory or Administrative Orders or Consent Decrees and previous recommendations for further work or remedial actions that help characterize the environmental conditions of the OU.

Background information is obtained by a review of both published and unpublished literature about the OU and the surrounding region, and data obtained from an OU visit by the Contractor. This information is included in the RI Report to

explain the basis for the design of the field investigations (e.g., soil borings, monitor well installations, water level measurements, aquifer tests, sampling and analysis, etc.) defined in the Work Plan and presented later in the report.

2.1.2 RI Report Organization

This section of the report specifies how the report is organized. The purpose for each section will be summarized.

2.2 Study Area Investigation

This section provides a detailed description of each of the field activities conducted during the course of the investigation and the rationale behind the activity. In addition, the activities conducted are compared to the activities specified in the Work Plan, so that it may be determined whether the specified project objectives and data quality objectives were achieved. Deviations from the Work Plan also are addressed and rationales given for the addition or deletion of any particular activity.

Results of the field activities (both physical and chemical) are presented in subsequent sections of the report, as discussed in Section 2.3. The descriptions in this section may include both physical and chemical monitoring of selected areas, possibly including the following investigations:

- Surface Features
- Contaminant Source Investigations
- Meteorological Investigations
- Surface Water and Sediment Investigations
- Geological Investigations
- Soil and Vadose Zone Investigations

- Ground-Water Investigations
- Human Population Surveys
- Ecological Investigations

2.3 Physical Characteristics of the Study Areas

2.3.1 Surface Features

Documentation of information about surface features such as topographic, natural, and manmade features obtained during field activities is presented in this section. Also included in this section will be OU and regional survey maps showing baseline monuments, benchmarks, reference grids, coordinates, scale, compass, and topography.

2.3.2 Geological Investigations

This section presents the results of geological studies undertaken to obtain information about the regional and OU geology for both unconsolidated overburden and bedrock formations. Included will be results of OU reconnaissance mapping, and field mapping of surficial soil, overburden units, bedrock outcrops, surface water drainage, springs, seeps, etc. This information may also include results of surface geophysics studies that were conducted.

2.3.3 Soils

This section discusses the results of activities conducted to obtain information about the shallow soils and the vadose zone. The data gathered may be divided into three primary categories: (1) soil physical characteristics; (2) vadose zone characteristics; and

(3) soil chemistry characteristics. The soil chemistry characteristics will be discussed in detail in Section 2.4.

The soil characteristics data presented here may be obtained directly from the results of current field activities including borehole sampling and laboratory measurements using ASTM methods to determine geotechnical soil characteristics. Other information that may be presented includes water budget studies, seepage rates, infiltration tests, results from test basins and other procedures.

2.3.4 Surface Water Hydrology

Surface water features may include erosion patterns and surface-water bodies such as ditches, streams, ponds, and lakes. The surface water data that will be presented in this section will include: (1) drainage patterns; (2) surface water bodies, including flow stream widths and depths, channel elevations, and physical dimensions of surface water impoundments; (3) physical structures; and (4) surface water/ground water hydraulic relationships.

2.3.5 Hydrogeology

This section will address the geologic, hydraulic and ground-water use aspects of the OU being investigated. Information presented in this section shall be divided into two major categories as follows: (1) ground-water occurrence (defining aquifer boundaries and locations, aquifer ability to transmit water; and (2) ground-water movement (defining direction of flow, rate of flow, and rate of recharge/discharge).

2.3.6 Meteorology

Information presented in this section will include the following data: (1) local climate, including precipitation, temperature, wind speed and direction, and presence of inversion layers; and (2) weather extremes, including storms, floods and winds.

2.3.7 Demography and Land Use

In this section the information presented will serve to identify, enumerate, and characterize human populations potentially exposed to contaminants released from the Site. Information about human populations in the study area and surrounding community that will be presented, include the following: (1) size; (2) location; (3) potentially sensitive subpopulations such as, children, pregnant women, infants, and the chronically ill; (4) a cross reference linkage of high-risk subpopulations to the contaminants of area to show risk; and (5) the type and extent of human contact with contaminated media, including data on the (a) location and use of surface waters, (b) local use of ground water as a drinking water source, (c) human use or access to the OU and adjacent areas, and (d) location of population with respect to the OU.

2.3.8 Ecological Investigations

Biological and ecological information will be collected for use in the risk assessment because it aids in the evaluation of impacts to the environment associated with a hazardous waste site and also helps to identify potential effects with regard to the implementation of remedial actions. The information presented will include: (1) general identification of flora and fauna in and around the site; (2) identification of endangered and threatened

species; (3) identification of species consumed by humans or found in human food chains; (4) identification of critical habitats; (5) land use characteristics; and (6) water use characteristics.

2.4 Nature and Extent of Contamination

The final objective of the field investigations is to characterize the nature and extent of contamination. This process involved using the physical OU characterization data, described in Section 2.3 to develop appropriate sampling and analysis programs. Laboratory analyses will be reported on the basis of sample matrix type; soil, sediment, ground water, surface water, or air. This will help to minimize transcription errors in the presentation of the data in tables.

2.5 Contaminant Fate and Transport

Following the development of physical data, the determination of contaminant sources and the completion of sampling and analysis, an analysis of contaminant fate and transport is conducted. If information on the release of contaminants is available, the observed extent of contamination may be used in assessing the transport pathway's rate of migration and the fate of contaminants over the period between release and monitoring. Contaminant fate and transport also may be estimated on the basis of OU physical characteristics and source characteristics. The results of the contaminant fate and transport analysis including appropriate models is presented in this section.

2.6 Baseline Risk Assessment

Baseline risk assessments provide an evaluation of the potential threat to human health and the environment in the absence

of any remedial action. They provide the basis for determining whether or not remedial action is necessary and the justification for performing remedial actions. For the RI report, the risk assessment will be presented in two major sections: (1) Human Health Evaluation, and (2) Environmental Evaluation. The risk assessment process which leads to the development of these separate evaluations can be divided into four components: (1) Contaminant identification; (2) Exposure assessment; (3) Toxicity assessment; and (4) Risk Characterization. All of these elements will be presented within the risk assessment in the RI report.

2.7 Summary and Conclusions to the RI Report

The RI report summary will be divided into a minimum of three separate discussions: (1) Nature and Extent of Contamination; (2) Fate and Transport Mechanisms; and (3) Risk Assessment. The RI report conclusion will discuss: (1) Data limitations and Recommendations for Additional Assessment Work; and (2) Recommended Remedial Action Objectives.

3.0 TREATABILITY STUDY REPORT

Treatability study reports are required for summarizing the methodology used and data collected during bench-scale and/or pilot-scale treatability studies. Bench-scale and pilot-scale testing programs are typically used to evaluate remedial technologies for air pollution and gas migration control; surface water and leachate generation control; thermal treatment; solidification/stabilization; biological, physical and chemical treatment; and in-situ treatment. The Treatability Study Format Checklist presented in Section 8.0 will be referenced to ensure that all necessary sections of the report are included.

The bench-scale and pilot-scale treatability study work plans include sections on project description and background, remedial technology description, test objectives, parameters to be tested, analytical methods, data management, data analysis and interpretation, health and safety, and residuals management. The bench-scale work plan also discusses specialized equipment and material needs, laboratory test procedures, and treatability test plan matrix. In the pilot-scale work plan, the following items are discussed; pilot plant installation and start-up, plant operation, and plant maintenance.

4.0 FEASIBILITY STUDY REPORT

The FS Report presents summaries of the results of the RI, including the risk assessment and Treatability Study results. The results of the RI, risk assessment, and Treatability Studies are used to identify remedial action objectives and develop, screen, and evaluate remedial action alternatives in the FS Report. The Feasibility Study Report Format Checklist presented in Section 8.0 will be referenced to ensure that all necessary sections of the report are included.

The remedial action objectives are used to identify general response actions and associated remedial technologies. Potentially applicable remedial technologies are screened for implementability, effectiveness, and relative cost. A detailed analysis is performed on selected alternatives to determine the remedial alternative most appropriate in addressing the remedial action objectives. The detailed analysis employs the following nine EPA criteria: compliance with ARARs; overall protection of human health and the environment; long-term effectiveness and permanence; reduction of toxicity, mobility, and volume; short-term effectiveness; implementability; cost; state acceptance; and community acceptance.

5.0 FINAL REPORT FORMATS

This section of the Final Product/Report QA/QC Plan defines the format and table of contents for the Final Product/Report. Checklists identifying the necessary components of the Reports described in Sections 2.0, 3.0, and 4.0 are presented in Section 8.0 The checklists will be referenced to ensure the proper completion of the final RI, Treatability Study, and FS Reports.

6.0 REVIEW PROCESS

This section of the Final Product/Report QA/QC Plan defines the review process by which each of the Work Plan Elements will be reviewed and validated. The hierarchy for this review process will involve the following steps:

- Collection of the applicable information and data, both from existing literature, records, documents, etc., and current site visits and environmental investigation work.

- Preparation of appropriate records and report components by designated personnel.

- Review of records and report components as generated by the QAO for accuracy, completeness, applicability to the stated task and achievement of stated DQOs and ARARs. Validation of sampling and analytical results, including analytical contract compliance screening, and data usability determination and classification. Review of completed checklists and associated product components.

- Review of report components and records as generated prior to preliminary Report preparation; review by the Project Manager, Project Officer, Project Engineer.

- Review of draft preliminary report by QAO, and Project Manager for technical competence and scientific merit, grammatical correctness, conciseness, and adherence to proper format.

- Review by Project Officer, Project Engineer and Navy Representative.

- Review of Comments from Navy.

- Preparation of appropriate revisions to preliminary report, review by pertinent project staff and project officer and resubmittal.

- Preparation of final report and review by QAO, Project Manager, Project Engineer, Project Officer and submittal to Navy.

7.0 CONCLUSION SUMMARY

Upon completion of validation of the information, a critique of the QA/QC efforts will be prepared and included in the Final Product/Report. Addressed in this critique will be details of the QA/QC Program implementation and its successes and failures with accompanying corrective actions taken.

8.0 CHECKLISTS

This section presents the check-off sheets to be used for the preparation of the project reports.

REMEDIAL INVESTIGATION REPORT FORMAT CHECKLIST

PAGE ONE

SECTION	TOPIC	REPORTED YES	REPORTED NO	ACCEPTABLE YES	ACCEPTABLE NO	NOT REQUIRED
--	Executive Summary	____	____	____	____	____
1.0	Introduction	____	____	____	____	____
1.1	Purpose of Report	____	____	____	____	____
1.2	OU Background	____	____	____	____	____
1.2.1	OU Description	____	____	____	____	____
1.2.2	OU History	____	____	____	____	____
1.2.3	Previous Investigations	____	____	____	____	____
1.3	Report Organization	____	____	____	____	____
2.0	Study Area Investigation - OU Characterization Tasks					
2.1	Field Activities Descriptions	____	____	____	____	____
2.1.1	Surface Features	____	____	____	____	____
2.1.2	Contaminant Sources	____	____	____	____	____
2.1.3	Meteorological Investigation	____	____	____	____	____
2.1.4	Surface-Water Investigation	____	____	____	____	____
2.1.5	Sediment Investigation	____	____	____	____	____
2.1.6	Geological Investigation	____	____	____	____	____
2.1.7	Soil and Vadose Zone Investigation	____	____	____	____	____
2.1.8	Ground-Water Investigation	____	____	____	____	____
2.1.9	Human Population Survey	____	____	____	____	____
2.1.10	Ecological Investigation	____	____	____	____	____
2.2	Technical Memoranda	____	____	____	____	____
3.0	Physical Characterization of Study Area					
3.1	Surface Features	____	____	____	____	____
3.2	Geological Investigation	____	____	____	____	____
3.3	Soils	____	____	____	____	____
3.4	Surface Water Hydrology	____	____	____	____	____
3.5	Hydrogeology	____	____	____	____	____
3.6	Meteorology	____	____	____	____	____
3.7	Demography and Land Use	____	____	____	____	____
3.8	Ecological Investigation	____	____	____	____	____
4.0	Nature and Extent of Contamination					
4.1	Ground Water	____	____	____	____	____
4.1.1	Dug (Test pits, trench)	____	____	____	____	____

REMEDIAL INVESTIGATION REPORT FORMAT CHECKLIST

PAGE TWO

SECTION	TOPIC	REPORTED YES	REPORTED NO	ACCEPTABLE YES	ACCEPTABLE NO	NOT REQUIRED
4.1.2	Wells	___	___	___	___	___
4.1.3	Potable Water (Wells)	___	___	___	___	___
4.2	Surface-Water	___	___	___	___	___
4.2.1	Lakes, rivers, stream	___	___	___	___	___
4.2.2	Surface Impoundments	___	___	___	___	___
4.2.3	Marine water bodies	___	___	___	___	___
4.3	Sediments	___	___	___	___	___
4.4	Soil	___	___	___	___	___
4.4.1	Surface Soil	___	___	___	___	___
4.4.2	Soil Borings and Subsurface Soil	___	___	___	___	___
4.5	Sludge	___	___	___	___	___
4.6	Waste Streams	___	___	___	___	___
4.7	Waste Piles	___	___	___	___	___
4.8	Landfills	___	___	___	___	___
4.9	Closed/Open Containers	___	___	___	___	___
4.10	Ambient Air	___	___	___	___	___
5.0	Contaminant Fate and Transport					
5.1	Potential Routes of Migration	___	___	___	___	___
5.2	Contaminant Persistence	___	___	___	___	___
5.2.1	Estimated Persistence-Physical, Chemical, Biological	___	___	___	___	___
5.2.1.1	Ground Water	___	___	___	___	___
5.2.1.2	Surface-Water	___	___	___	___	___
5.2.1.3	Sediments	___	___	___	___	___
5.2.1.4	Soil	___	___	___	___	___
5.2.1.5	Sludge	___	___	___	___	___
5.2.1.6	Waste Streams	___	___	___	___	___
5.2.1.7	Waste Piles	___	___	___	___	___
5.2.1.8	Landfills	___	___	___	___	___
5.2.1.9	Closed/Open Containers	___	___	___	___	___
5.2.1.10	Ambient Air	___	___	___	___	___
5.3	Contaminant Migration	___	___	___	___	___
5.3.1	Ground Water	___	___	___	___	___
5.3.2	Potable Water (Wells)	___	___	___	___	___
5.3.3	Surface-Water	___	___	___	___	___
5.3.4	Sediments	___	___	___	___	___
5.3.5	Soil	___	___	___	___	___
5.3.6	Sludge	___	___	___	___	___
5.3.7	Waste Streams	___	___	___	___	___
5.3.8	Waste Piles	___	___	___	___	___
5.3.9	Landfills	___	___	___	___	___
5.3.10	Closed/Open Containers	___	___	___	___	___

REMEDIAL INVESTIGATION REPORT FORMAT CHECKLIST

PAGE THREE

SECTION	TOPIC	REPORTED YES	REPORTED NO	ACCEPTABLE YES	ACCEPTABLE NO	NOT REQUIRED
5.3.11	Ambient Air	___	___	___	___	___
5.4	Modeling	___	___	___	___	___
6.0	Baseline Risk Assessment	___	___	___	___	___
6.1	Human Health Evaluation	___	___	___	___	___
6.1.1	Exposure Assessment	___	___	___	___	___
6.1.2	Toxicity Assessment	___	___	___	___	___
6.1.3	Risk Characterization	___	___	___	___	___
6.2	Environmental Evaluation	___	___	___	___	___
7.0	Summary and Conclusions	___	___	___	___	___
7.1	Summary	___	___	___	___	___
7.1.1	Nature and Extent of Contamination	___	___	___	___	___
7.1.2	Fate and Transport	___	___	___	___	___
7.1.3	Risk Assessment	___	___	___	___	___
7.2	Conclusions	___	___	___	___	___
7.2.1	Data Limitations	___	___	___	___	___
7.2.2	Recommended Future Work	___	___	___	___	___
7.2.3	Recommended Remedial Action Objectives	___	___	___	___	___
Appendices		___	___	___	___	___

TREATABILITY STUDY REPORT FORMAT CHECKLIST

PAGE ONE

SECTION	TOPIC	REPORTED YES	REPORTED NO	ACCEPTABLE YES	ACCEPTABLE NO	NOT REQUIRED
Bench-Scale Work Plan Format						
1.0	Project Description and OU Background	___	___	___	___	___
2.0	Remediation Technology Description	___	___	___	___	___
3.0	Test Objectives	___	___	___	___	___
4.0	Specialized Equipment and Materials	___	___	___	___	___
5.0	Laboratory Test Procedures	___	___	___	___	___
6.0	Treatability Test Plan Matrix and Parameters To Measure	___	___	___	___	___
7.0	Analytical Methods	___	___	___	___	___
8.0	Data Management	___	___	___	___	___
9.0	Data Analysis and Interpretation	___	___	___	___	___
10.0	Health and Safety	___	___	___	___	___
11.0	Residuals Management	___	___	___	___	___
12.0	Conclusions and Recommendations	___	___	___	___	___
Pilot-Scale Work Plan Format						
1.0	Project Description and OU Background	___	___	___	___	___
2.0	Remediation Technology Description	___	___	___	___	___
3.0	Test Objectives	___	___	___	___	___
4.0	Pilot Plant Installation and Start-up	___	___	___	___	___

TREATABILITY STUDY REPORT FORMAT CHECKLIST

PAGE TWO

SECTION	TOPIC	REPORTED YES	REPORTED NO	ACCEPTABLE YES	ACCEPTABLE NO	NOT REQUIRED
Pilot-Scale Work Plan Format (Continued)						
5.0	Pilot Plant Operation and Maintenance Procedures	___	___	___	___	___
6.0	Parameters to be Tested	___	___	___	___	___
7.0	Sampling Plan	___	___	___	___	___
8.0	Analytical Methods	___	___	___	___	___
9.0	Data Management	___	___	___	___	___
10.0	Data Analysis and Interpretation	___	___	___	___	___
11.0	Health and Safety	___	___	___	___	___
12.0	Residuals Management	___	___	___	___	___
13.0	Conclusions and Recommendations	___	___	___	___	___

FEASIBILITY STUDY REPORT FORMAT CHECKLIST

PAGE ONE

SECTION	TOPIC	REPORTED YES	REPORTED NO	ACCEPTABLE YES	ACCEPTABLE NO	NOT REQUIRED
--	Executive Summary	____	____	____	____	____
1.0	Introduction	____	____	____	____	____
1.1	Purpose and Organization of Report	____	____	____	____	____
1.2	Background Information	____	____	____	____	____
1.2.1	OU Description	____	____	____	____	____
1.2.2	OU History	____	____	____	____	____
1.2.3	Nature and Extent of Contamination	____	____	____	____	____
1.2.4	Contaminant Fate and Transport	____	____	____	____	____
1.2.5	Baseline Risk Assessment	____	____	____	____	____
2.0	Identification and Screening of Technologies					
2.1	Introduction	____	____	____	____	____
2.2	Remedial Action Objectives	____	____	____	____	____
2.2.1	Contaminants of Interest	____	____	____	____	____
2.2.2	Remedial Action Goals	____	____	____	____	____
2.2.3	Development of Remediation Goals	____	____	____	____	____
2.3	General Response Actions	____	____	____	____	____
2.4	Identification and Screening of Technology Types and Process Options	____	____	____	____	____
2.4.1	Identification and Screening of Technologies	____	____	____	____	____
2.4.2	Evaluation of Technologies and Selection of Representative Technologies	____	____	____	____	____
3.0	Development and Screening of Alternatives					
3.1	Development of Alternatives	____	____	____	____	____
3.2	Treatability Study Results	____	____	____	____	____
3.3	Screening of Alternatives	____	____	____	____	____
3.3.1	Introduction	____	____	____	____	____
3.3.2	Alternative 1	____	____	____	____	____
3.3.2.1	Description	____	____	____	____	____
3.3.2.2	Evaluation	____	____	____	____	____

FEASIBILITY STUDY REPORT FORMAT CHECKLIST

PAGE TWO

SECTION	TOPIC	REPORTED YES	REPORTED NO	ACCEPTABLE YES	ACCEPTABLE NO	NOT REQUIRED
3.3.3	Alternative 2	___	___	___	___	___
3.3.3.1	Description	___	___	___	___	___
3.3.3.2	Evaluation	___	___	___	___	___
3.3.4	Alternative 3	___	___	___	___	___
3.3.4.1	Description					
3.3.4.2	Evaluation					
4.0	Detailed Analysis of Alternatives					
4.1	Introduction	___	___	___	___	___
4.2	Individual Analysis of Alternatives	___	___	___	___	___
4.2.1	Alternative 1	___	___	___	___	___
4.2.1.1	Description	___	___	___	___	___
4.2.1.2	Detailed Analysis	___	___	___	___	___
4.2.2	Alternative 2	___	___	___	___	___
4.2.2.1	Description	___	___	___	___	___
4.2.2.2	Detailed Analysis	___	___	___	___	___
4.2.3	Alternative 3	___	___	___	___	___
4.2.3.1	Description					
4.2.3.2	Detailed Analysis					
4.3	Comparative Analysis	___	___	___	___	___
Bibliography		___	___	___	___	___
Appendices		___	___	___	___	___

APPENDIX 4.4

Basic Sampling and Analysis Plan

Appendix 4.4.1 Quality Assurance Program Plan (QAPP)

Appendix 4.4.2 Basic Field Sampling Plan (BFSP)

APPENDIX 4.4.1

Quality Assurance Program Plan (QAPP)

BASIC SAMPLING AND ANALYSIS PLAN
QUALITY ASSURANCE PROGRAM PLAN
AT THE NAVAL AIR STATION
JACKSONVILLE, FLORIDA

Prepared for

SOUTHERN DIVISION
DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND
CHARLESTON, SOUTH CAROLINA

September 1991

Prepared by

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TAMPA, FLORIDA 33618

Revision 1

BASIC SAMPLING AND ANALYSIS PLAN
QUALITY ASSURANCE PROGRAM PLAN
AT THE NAVAL AIR STATION
JACKSONVILLE, FLORIDA

Prepared for

SOUTHERN DIVISION
DEPARTMENT OF THE NAVY
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CHARLESTON, SOUTH CAROLINA

February 1992

Revised by

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TALLAHASSEE, FLORIDA 32301

CONTENTS

Revision 1

CONTENTS

Revision 1

CONTENTS

Revision 1

TABLES

TABLES (Continued)

FIGURES

ATTACHMENTS (BOOK 2 OF VOLUME 4)

A. CH2M Hill. Comprehensive Quality Assurance Manual.

B. Environmental Science & Engineering, Inc. Quality Assurance/Quality Control Manual.

C. ENESCO - California Analytical Laboratory. QAPP for Analysis of Polychlorinated Dioxins/Furans by Low Resolution GC/MS.

D. (Reserved)

E. (Reserved)

F. (Reserved)

G. ABB-ES Calibration Procedures and Frequencies.

H. Engineering Compliance Branch, Standard Operating Procedures and Quality Assurance Manual, U.S. Environmental Protection Agency, Environmental Services Division, Athens, Ga., February 1991.

I. Aqueous Preservation Protocol for Cyanide.

J. ABB-ES Preventive Maintenance Procedures for Field Equipment.

K. Resumes of Key ABB-ES Personnel.

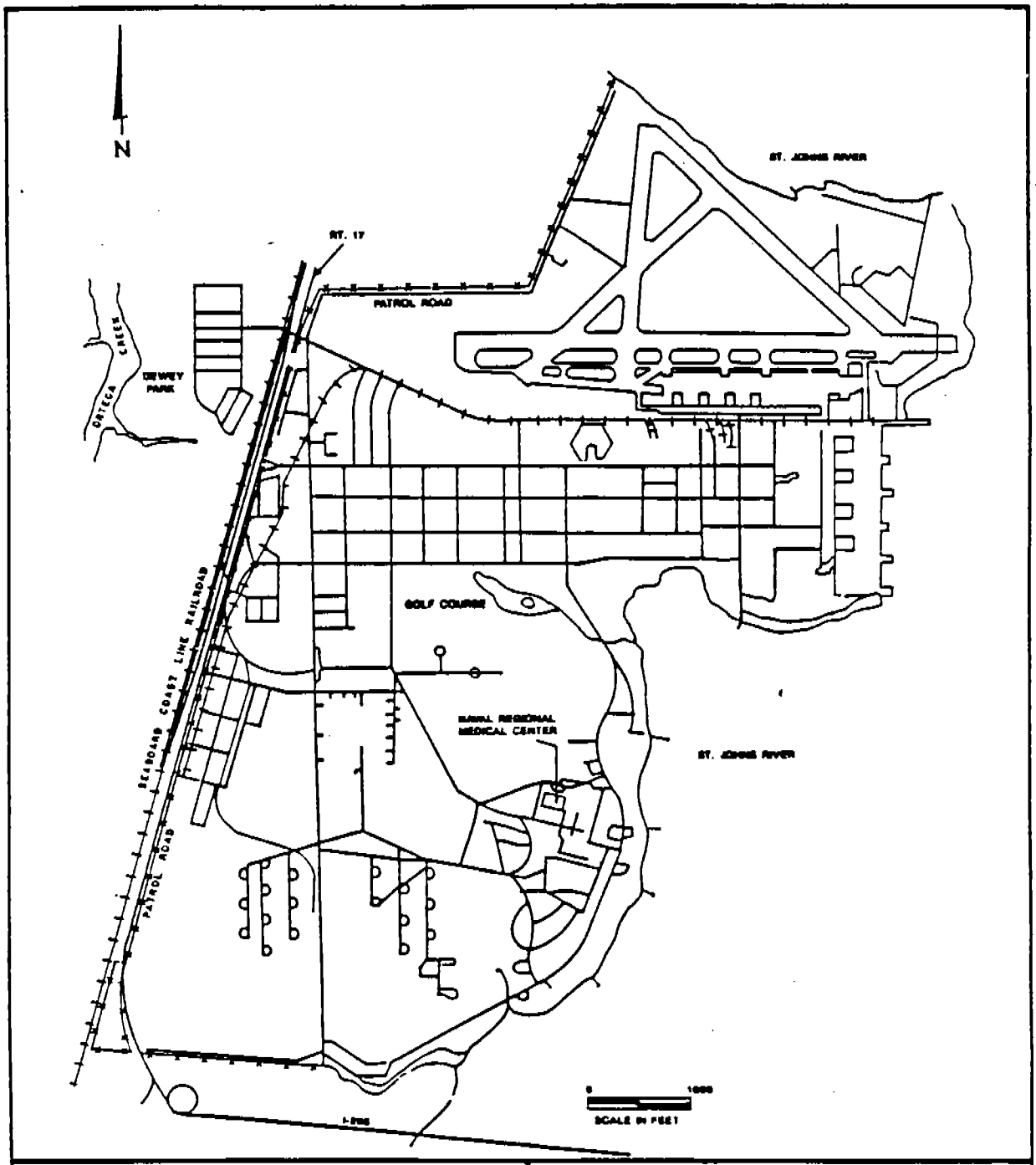
1.0 PROJECT DESCRIPTION

In accordance with the Federal Facilities Agreement, the United States Navy, Southern Division, Naval Facilities and Engineering Command has prepared a Remedial Investigation/ Feasibility Study (RI/FS) Work Plan for selected sites at the Naval Air Station (Site), located in Jacksonville, Florida (Figure 1-1). The sites to be investigated, referred to as potential sources of contamination (PSCs), are shown in Figure 1-2. The basis for the selection of these PSCs and the grouping of PSCs into operable units (OUs) is presented in Section 5.0, Site Prioritization and Section 6.0, Event Scheduling of Volume 1 Organization and Planning. This document addresses the quality control procedures that will be utilized for the data collection efforts conducted during the investigation of PSCs identified for study at the Site.

1.1 Project Background

The Site was commissioned in October 1940 to function as a support facility for Naval aviation operations including training for pilots and ground support personnel, maintenance of aircraft and service as a seaplane base. The Site expanded significantly with the advent of World War II (WW II) reaching its peak of 42,000 naval and 11,000 civilian personnel in 1946.

Military force reduction subsequent to WW II and relocation of various naval commands resulted in the re-establishment of training and maintenance functions as the primary role of the Facility. As a training facility for ground-crew and a major facility for aircraft maintenance, a wide variety of hazardous materials were utilized and disposed of at the Site. The types of wastes

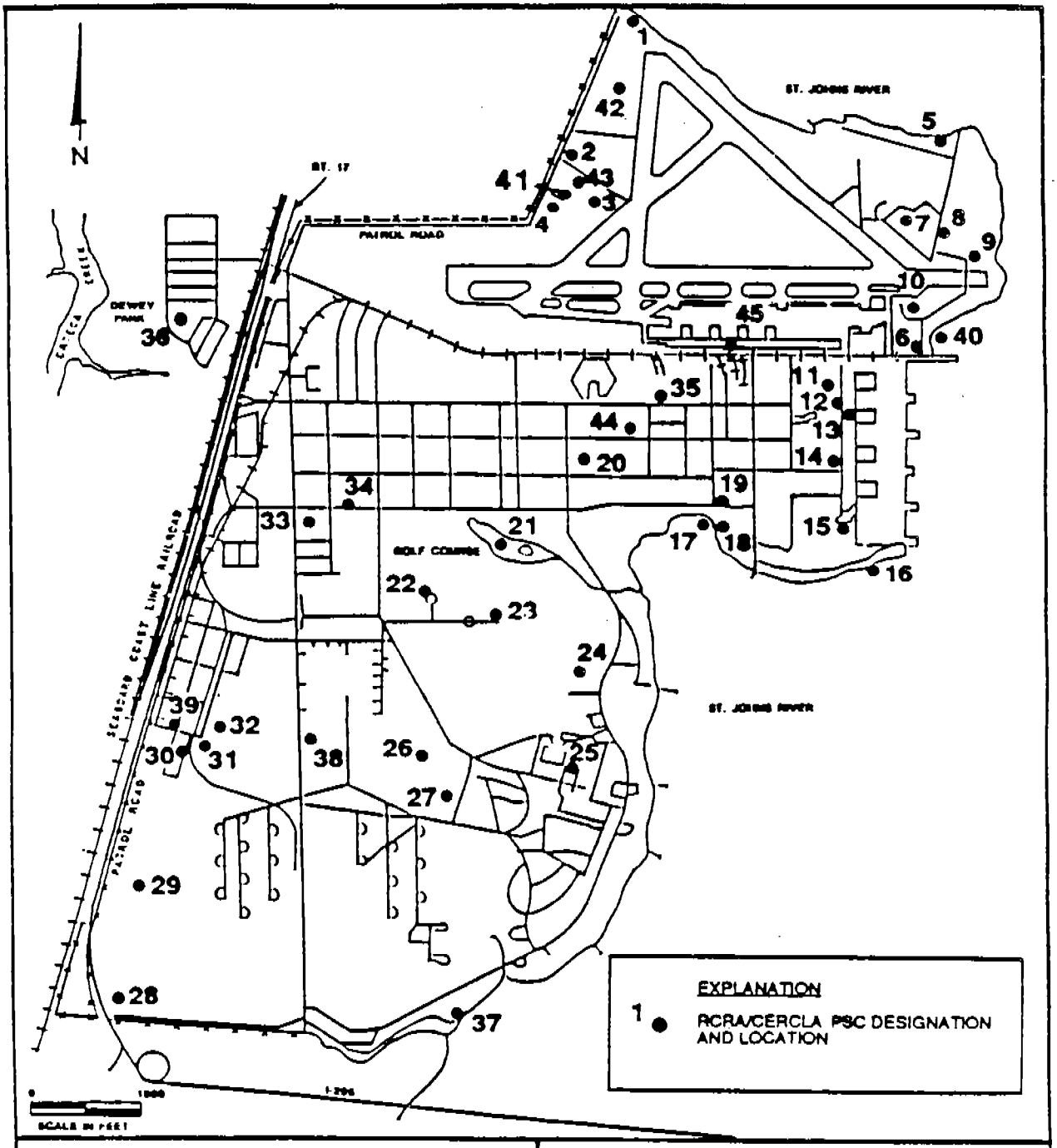


SITE LOCATION MAP
FOR NAVAL AIR STATION,
JACKSONVILLE, FLORIDA

FIGURE 1-1

REMEDIAL INVESTIGATION
FEASIBILITY STUDY
QUALITY ASSURANCE
PROGRAM PLAN

NAS JACKSONVILLE
SEPTEMBER 1991



LOCATIONS OF PSCs AT NAVAL AIR STATION, JACKSONVILLE, FLORIDA

FIGURE 1-2

REMEDIAL INVESTIGATION
FEASIBILITY STUDY
QUALITY ASSURANCE
PROGRAM PLAN

NAS JACKSONVILLE
SEPTEMBER 1991

generated at the Site have included metal plating wastes, paint strippers, various chlorinated and oxygenated solvents, radio nuclides, pesticides, photographic wastes, waste petroleum oils and lubricants, as well as domestic waste. In addition, handling and storage of aircraft fuel, jet fuel, and motor vehicle fuel in above ground and underground storage tanks has led to documented discharges of these petroleum products to the environment.

As part of the Navy's effort to address public health and environmental concerns related to waste disposal practices, a number of activities have been conducted at the Site to investigate and/or mitigate potential environmental impacts. Significant actions have included, but are not limited to, excavation of radioactive paint waste from the Radium Paint Waste Disposal Pit (PSC 13) in the late 1950s; excavation of radioactive waste materials from the Old Main Registered Disposal Area (PSC 26) in 1974; investigation of the Pits Site (PSC 26 and 27) in 1979; interim remedial actions at the Pits Site conducted in 1983 and 1984; and investigation/interim remediation of the Sludge Disposal Area/Sewage Treatment Plant Area (PSC 3) in 1987 and 1988.

In 1982, Fred C. Hart & Associates, under contract to the Naval Energy and Environmental Support Activity (NEESA), conducted an Initial Assessment Study (IAS) of the Site. The study included a records search of federal, state, and local public health and environmental agency documents, and a site visit. The final report prepared in March of 1983, titled Initial Assessment Study, Naval Air Station Jacksonville, Florida, VIC No. N00207, Naval Fuel Depot, Jacksonville, Florida, VIC No. N62566, identified a total of 38 PSCs. This report, in conjunction with data from previous

investigations, was used in developing the scope of work presented in the Work Plan.

1.2 Documents

The Basic Sampling and Analysis Plan (BSAP) has been prepared to describe procedures used to obtain quality field and laboratory data during the implementation of the RI/FS. The BSAP consists of two documents: a Quality Assurance Program Plan (QAPP) and a Basic Field Sampling Plan (BFSP). The QAPP has been prepared according to the guidelines set forth by the U.S. Environmental Protection Agency (EPA) in "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans", (QAMS-005/80), EPA. The QAPP also meets the requirements specified by the Naval Energy and Environmental Support Activity in the document entitled "Sampling and Chemical Analysis Quality Assurance Requirements for the Navy Installation Restoration Program", NEESA 20.2-047B, June 1988. The QAPP has been structured as a generic document to provide general guidance to the field and laboratory personnel concerning methodologies of data collection, proper record keeping protocols, data quality objectives, and procedures for data review.

The BFSP has been prepared to define the specific sampling procedures and techniques to be employed in the collection of soil, sediment, solid waste, sludge, surface water, ground water, and air samples during the investigation. The procedures specified in this document also meet the requirements specified in the NEESA 20.2-047B, June 1988 document.

One primary analytical laboratory has been selected to perform the bulk of the laboratory analyses along with two additional

laboratories to conduct selected specialty analyses. Operating information and a generic Laboratory Quality Assurance Plan (QAP) concerning all three laboratories has been included in this QAPP in Attachments A, B, and C. Accuracy, precision, and completeness criteria for the potential chemical constituents and radionuclides to be evaluated is presented for each laboratory in Table 1-1 and in Section 3.0. Prior to investigation of each OU, an OU-Specific Field Sampling Plan (OU FSP), and an OU-Specific Quality Assurance Project Plan (QAPjP) will be prepared. The QAPjP will specify the specific target compounds to be evaluated and which of the primary analytical laboratory and specialty laboratories, if required, will conduct the analyses pertinent to the investigation.

In addition, a wide variety of investigatory techniques have been included in the BFSP and QAPP. However, not all of the techniques are anticipated to be used at each PSC. Selection of specific data gathering methodologies will be made for each OU during preparation of the OU FSP and the QAPjP.

Each QAPjP will contain the same sections as the QAPP and will be organized in the same format. In general, the methodologies used for each OU's investigation will be selected from the options presented in the QAPP, the BFSP, and selected remedial investigation field task investigation plans, and will be incorporated by reference into the site specific plans. When OU conditions require modifications to techniques documented in the QAPP and BFSP, or require the use of specialized procedures not presented in these documents, the OU-specific plans (QAPjP and

OU FSP) will provide a detailed description of the proposed technique and the technical justification for its use.

1.3 Scope of Work

The principal objectives of the RI/FS for the selected OUs and surrounding site areas are: (1) determine the extent (vertical and horizontal) and concentration of detected contaminants, (2) identify and characterize the sources of contamination, (3) assess the potential for contaminant migration to surrounding environments, (4) identify public health and environmental risks of the identified contaminants, and (5) define the scope of future investigations and/or required remedial actions, if warranted. To accomplish these objectives, the Contractor will perform numerous data gathering tasks including waste characterization, hydrogeologic, soil and sediment, surface water, air, biological, and radiological investigations.

The selection of data collection, sample collection locations, and constituents of interest, will be based on the review of existing laboratory and field data, the results of OU observations, and defined Applicable or Relevant and Appropriate Requirements (ARARs). Sample collection techniques and the sample analysis methods, discussed in Sections 1.0, 4.0, and 7.0, were chosen based on recommendations provided in guidance documents prepared and approved by EPA for use in conducting a RI/FS and in compliance with requirements specified in the document entitled "Sampling and Chemical Analysis Quality Assurance Requirements for the Navy Installation Restoration Program (NIRP)", NEESA 20.2-047B, June 1988.

1.4 Designated Tasks

The following sections of the QAPP briefly describe tasks that may be performed during investigations of selected PSCs. These tasks include (1) geophysical surveys; (2) radiological surveys; (3) geotechnical tests; (4) sampling and analysis; and (5) data analysis and final report preparation.

1.4.1 Geophysical Surveys

Prior to initiation of drilling activities or excavations, a geophysical survey may be conducted. Data from geophysical surveys can be used to locate underground storage tanks, product piping and transfer lines, drums, metal debris, and other types of metallic waste. In addition, the areal extent of ground-water plumes can be estimated using these methods because plumes of impacted ground water often contain elevated levels of dissolved ions. After the geophysical information is reviewed, the data will be used to further develop and refine drilling and excavation programs for each PSC. The types of geophysical measurements that may be conducted include: magnetic surveys, electromagnetic measurements, and resistivity surveys. More specific information concerning the use of available geophysical surveys is presented in Section 4.2 of the BFSP (Appendix 4.4.2).

1.4.2 Radiological Survey

Based on historical data for each OU, radiological surveys, as described in the Radiological Investigation Plan (Section 3.6 of the Basic Site Work Plan) will be conducted at the appropriate PSCs. The survey grid and survey equipment will be selected based

on the radionuclides suspected to have been present at the OU. Typically gamma survey equipment will be initially utilized due to its wide areal coverage and its ability to detect many natural and man-made nuclides.

The results of the radiological survey of each PSC will be compared to a background survey to determine if detected radionuclides are a function of areal characteristics or due to the presence of specific radionuclides at the OU. This data will be used for health and safety purposes as well as to assess the regulatory status of the source material. Because radiological surveys can not detect certain alpha and beta emitting radioisotopes at levels that exceed drinking water MCLs, laboratory gross alpha and gross beta scans may be required at PSCs where radionuclides are known to have been stored.

1.4.3 Geotechnical Surveys

At selected PSCs the contractor will conduct sampling for geotechnical evaluation of subsurface soils and, if encountered, solid or semi-solid wastes. The testing that will be completed at each PSC will be determined during work plan development for each OU and presented in the OU FSP and QAPjP. The sampling and geotechnical analysis of soil will be conducted according to the standard American Society for Testing and Materials (ASTM) methods presented in Section 3.0 of this QAPP.

The data collected from the geotechnical analyses will be used to determine the properties of the local soils, assist in determining the velocity of the ground water migration as well as provide engineering information for preliminary screening of

remedial options prior to development of the Feasibility Study Work Plan.

Quality Assurance procedures for sample collection and sample representativeness are described in Section 4.0 of this QAPP and in appropriate sections of the BFSP (Appendix 4.4.2). Quality Assurance procedures utilized by the geotechnical laboratory are specified in each individual method.

1.4.4 Sampling and Analysis

Based upon the combined results of Jacksonville Naval Air Station historical data, observations from Site visits, the geophysical surveys, radiological surveys and geotechnical tests, the sampling and analysis plan for each PSC will be prepared. Sampling and analysis will be conducted in selected matrices as required. Potential matrices to be sampled and submitted for analysis will include soil (surface and subsurface from soil borings), sediment (from surface impoundments, ponds, rivers, streams, lakes, marine water bodies), sludge, waste stream, waste piles, landfills, surface water bodies, ground water from monitor wells, and ambient air. Samples will be taken from these selected matrices and analyzed to determine the nature and extent of chemical contaminants within the sample matrix. The specific samples to be collected, frequencies of sample collection, parameters, methods of analysis, detection limits, and appropriate field quality control samples will be described in each OU FSP and QAPjP. Specific sampling procedures are described in Section 4.0 of the BFSP (Appendix 4.4.2).

All samples collected for laboratory analysis will be properly preserved and packed by field sampling personnel according to the procedures specified in Section 4.0 and shipped under appropriate chain-of-custody procedures found in Section 5.0. As discussed earlier, a primary analytical laboratory has been designated for use during implementation of the Site Work Plan. They are CH2M Hill Laboratories of Montgomery, Alabama. Samples of ground water, surface water, soil, sediments, and solid waste for analysis of volatile organic compounds (VOCs), pesticides, base neutral, and acid extractable organic compounds (BNAs), metals, geotechnical samples, and other standard chemical water quality parameters will be shipped to the primary analytical laboratory designated in the QAPjP. A Generic Quality Assurance Plan for the primary laboratory is presented in Attachment A.

Samples requiring analysis of radionuclides and air toxics will be shipped to Environmental Science & Engineering, Inc. of Gainesville, Florida (ESE). Soil and water samples for analysis of dioxins and furans will be sent to ENESCO - California Analytical Laboratories, West Sacramento, California. Generic QAPs, or standard operating procedures for these laboratories, are presented in Attachments B, and C, respectively.

The analytical, geotechnical, and geophysical methods to be used during the course of the site investigation are presented in Tables 1-1, 3-1, and 3-2. References for the methods are contained in each table. All methods are approved and published in various EPA Documents and Manuals, the ASTM Manuals, Standard Methods (Seventeenth Edition) or The Federal Register.

The overall QC requirements to be observed by the contracted laboratories are described in Table 3-3. The EPA, through the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) has defined five general levels of analytical options to support collection of measurement data in terms of documenting achievement of specified data quality objectives (DQOs). For this program, the Navy has adopted two analytical levels as quality control requirements for attaining DQOs. These levels are referred to as Level D and Level C; they correlate with EPA Levels 3 and 4 described in the EPA document entitled Data Quality Objectives for Remedial Response Activities-Development Process (EPA 5401G-871003). These levels are based on the type of site to be investigated, the level of accuracy and precision required, and the intended end use of the data.

Level D QC is to be used for PSCs that are on or about to be on the National Priorities List (NPL). These PSCs, classified as Naval Installation Restoration Program (NIRP)-CERCLA sites, are typically near populated areas and are likely to undergo litigation. For Level D, the EPA Contract Laboratory Program (CLP) methods are used and the CLP data package generated. A laboratory capable of performing CLP approved procedures is used for this purpose.

Level C QC is used for all remaining Navy PSCs. For Level C, the laboratory that is used must have been qualified under CLP, but does not need to be a contracted CLP laboratory. Level C allows

the use of non-CLP methods, but requires that the methods used be EPA methods (Table 1-1 included at the end of this report). The specific QC performance requirements for each level and the required data package deliverables are described in Section 8.0 and 9.0, respectively.

1.5 Field Quality Assurance Sampling

During implementation of the field sampling program at each OU, the Contractor will collect field quality control samples to assess the reproducibility of the field collection techniques, the quality of preservation reagents and sample bottles, and the adequacy of field decontamination procedures. Field QC samples for both levels of QC (Levels D and C) will include the collection and analysis of equipment rinsate blanks, field blanks, trip blanks, field replicates (duplicates), and field (referee) split (duplicate) samples. Specific procedures and frequencies of preparation are summarized in Table 8-1 and discussed in Section 8.0.

1.6. Data Analysis and Report Preparation

After the completion of each sampling and analysis program, the field and analytical data will be reviewed, validated, and analyzed using appropriate checklists. All data will be classified for usability as described in Section 9.0 and summarized into appropriate tables, charts, and figures.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITY

This section provides a description of the organizational structure of personnel to be used on this project. This description illustrates the lines of authority and identifies the key personnel assigned to various activities for the project. A proposed organizational structure chart for the investigation is shown in Figure 2-1.

2.1 Authority and Responsibilities

The responsibilities of the individual positions for this project are described in the following sections.

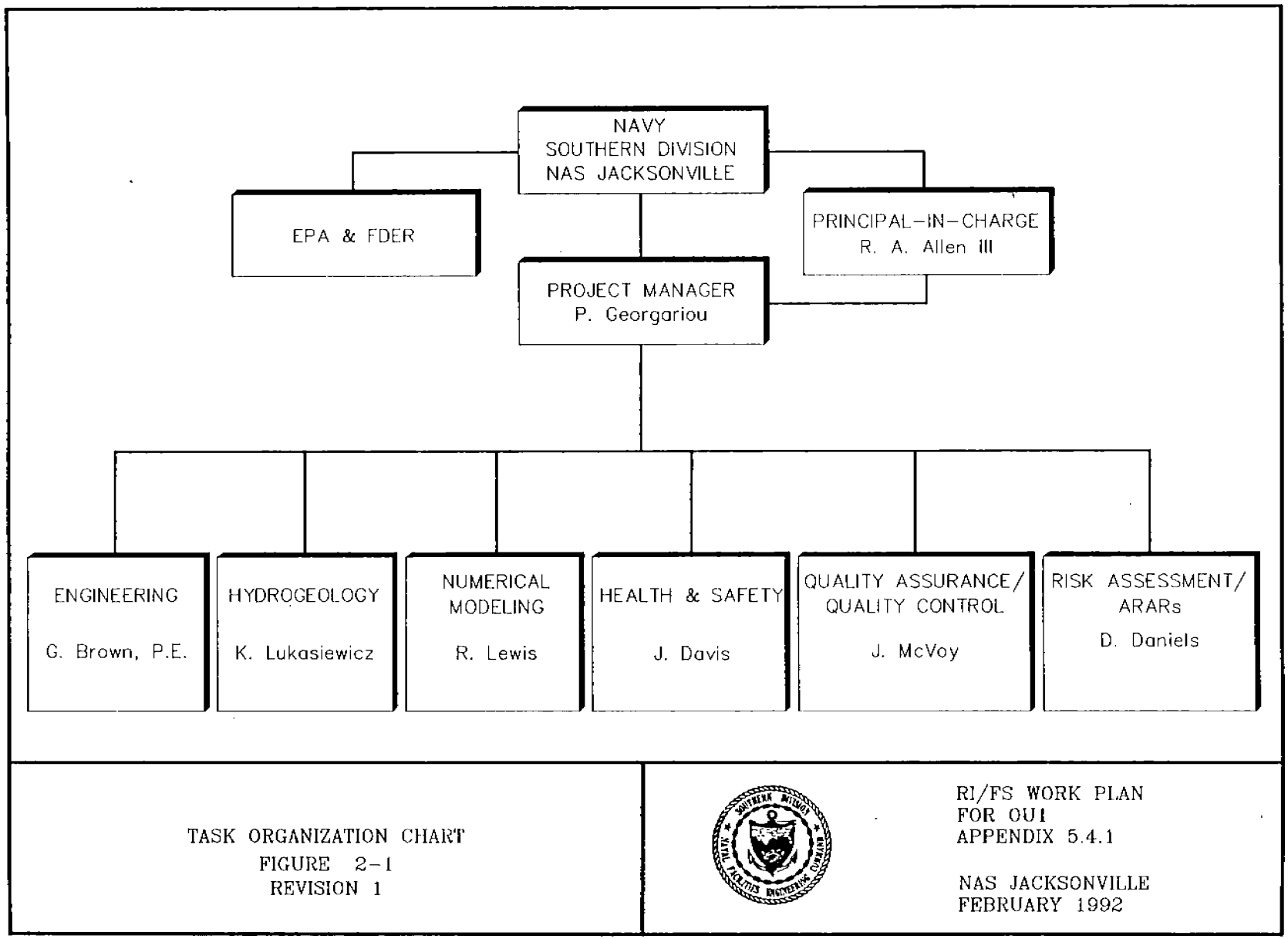
2.1.1 U.S. Navy Project Manager

Mr. Joel Murphy
Southern Division [Code 11512], Naval Facilities Engineering Command
2155 Eagle Drive, P.O. Box 10068
Charleston, SC 89411-0068

The U.S. Navy Project Manager will review and approve the work plans and work activities for the duration of the project and direct the coordination of U.S. Navy policy and environmental objectives.

2.1.2 Facility On-Site IR Manager

Mr. Kevin Gartland
Naval Air Station
Public Works Department, Engineering Division
Box 5, Code 184, 1841R Building 902
Jacksonville, Florida 32212-5000



TASK ORGANIZATION CHART
FIGURE 2-1
REVISION 1

RI/FS WORK PLAN
FOR OU1
APPENDIX 5.4.1

NAS JACKSONVILLE
FEBRUARY 1992

FILE: NASOCH7.DWG

The Facility On-Site IR Manager will be the primary contact at the Site. He will be responsible for Navy coordination of on-site activities described in the Work Plan. He will assure that all site activities conducted by the Contractor and its subcontractors are in agreement with the policies of the Navy and the NAS - Jacksonville.

2.1.3 A-E Program Manager

Mr. William Lawrence
ABB Environmental Services, Inc.
2590 Executive Center Circle East
Berkeley Building
Tallahassee, Florida 32301

The Program Manager is responsible for ABB-ES overall implementation of the project. As an officer of the firm, he has the authority to commit the necessary resources to ensure timely completion of project tasks. Other duties, as required, may include:

1) Coordination with the Project Manager concerning scheduling equipment and manpower.

2) Review of project progress.

3) Final review of all documents, plans, and drawings.

2.1.4 A-E Task Order Manager

Mr. Philip Georgariou
ABB Environmental Services, Inc.
2590 Executive Center Circle East
Berkeley Building
Tallahassee, Florida 32301

The Task Order Manager will serve as the primary ABB-ES contact for U.S. Navy personnel and subcontractors. Other duties, as required, may include:

1) Approval of project-specific procedures and internally prepared plans, drawings, and reports;

2) Ensuring that the technical, schedule, and control requirements established by the QA Officer are enforced on the project;

3) Serving as the "collection point" for the project staff reporting any changes or deviations from the project work plan; and

4) Determining the significance of these changes or deviations to the work plan, and the appropriateness for reporting such items to the appropriate regulatory and Navy representative.

5) Arranging subcontractor services;

6) Assigning duties to the project staff and orientation of the staff to the requirements of the project; and

7) Preparation of status update reports and revisions to the project work plan.

2.1.5 A-E Field Coordinator

Mrs. Kathy Lukasiewicz
ABB Environmental Services, Inc.
2590 Executive Center Circle East
Berkeley Building
Tallahassee, Florida 32301

The A-E Field Coordinator (Field Operations Leader (FOL)) principally is responsible for interacting with the Facility On-Site IR Manager to schedule the day-to-day field activities. Other duties required may include:

1) Review of on-site activities for compliance with the Site Work Plan.

2) Preparation of daily/weekly status report.

3) Resolution of on-site scheduling conflicts.

4) Monitoring of staff and subcontractor progress.

2.1.6 A-E Quality Assurance Officer

Mr. John C. McVoy
ABB Environmental Services, Inc.
2590 Executive Center Circle East
Berkeley Building
Tallahassee, Florida 32301

The Quality Assurance Officer (QA Officer) will be the liaison between the laboratories, ABB-ES, and the U.S. Navy. The QA

Officer will ensure the accuracy of the collected data through the performance of the following tasks:

1) Field and laboratory systems and performance audits;

2) Field sample collection and analytical QA program design;

3) Field and analytical data validation;

4) Selection of the analytical laboratory; and

5) Preparation of laboratory contracts.

2.1.7 Support Staff

In addition to the individuals previously mentioned, senior staff from ABB-ES office located in Tallahassee will be responsible for coordinating their specialized functions, respectively, during the implementation of the Site Work Plans. The resumes for the senior ABB-ES staff responsible for data collection and review are presented in Attachment K of the QAPP.

2.2 Primary Analytical Laboratory

A full service environmental laboratory has been selected to act as the primary analytical laboratories for this project. The laboratory is CH2M Hill of Montgomery, Alabama.

CH2M Hill
2567 Fairlane Drive
Montgomery, Alabama 36116-0548
(205) 271-1444
Attn: Spencer Hamil

2.2.1 CH2M Hill Laboratories

CH2M Hill Quality Analytical Laboratories specialize in performing trace organic and inorganic analyzes, operating three laboratories in Montgomery, Alabama; Gainesville, Florida; and Redding, California. CH2M Hill Quality Analytical Laboratories have been previously audited and certified by HAZWRAP, NEESA, Air Force IRP, EPA CLP PE Program, among others.

C. Vinson is the laboratory manager of CH2M Hill's Montgomery laboratory and is responsible for the overall operations of the laboratory facilities. T. Emenhiser will be the project manager and will be the primary coordinator between CH2M Hill and ABB-ES. M. Wisdom is the Laboratory Quality Assurance Coordinator and will be responsible for monitoring the accuracy, validity, and reliability of the data by implementing the laboratory's quality assurance program. Resumes of CH2M Hill's key personnel at their Montgomery facility are included in Attachment A.

2.3 Special Service Laboratories

In addition to the primary analytical laboratories presented in Section 2.2, two special services laboratories will be required to analyze samples for specific constituents that are not routinely evaluated by the primary laboratories. The laboratories selected to conduct these analyses include Environmental Science & Engineering, Inc. of Gainesville, Florida for the analysis of radionuclides.

2.3.1 Environmental Science & Engineering, Inc.

Environmental Science & Engineering, Inc. (ESE) is a full service environmental laboratory with capabilities in the area of radiological analyses. ESE has been approved and/or certified to conduct analyses for the U.S. Navy under the auspices of NEESA/NACIP. In addition, ESE has participated in certification/ approval programs for a number of states, including Florida.

ESE's Laboratory Director is Mr. John Mousa. The Laboratory Project Manager assigned to this project by ESE is Mr. Jeff Shamis. ESE's Quality Assurance Officer for this project will be Portia Pisigan. The personnel qualifications of ESE's staff and their organization is presented in Attachment D of this QAPP.

Mr. Shamis will act as the primary contact for CH2M Hill and ABB-ES during implementation of this work plan and he will be responsible for review of analytical data as well as review of the final analytical report submitted for this project. Mr. Shamis also will be involved with scheduling of sample receipt, sample handling practices, and assuring that analyses are completed and reported in a timely manner.

Ms. Pisigan will be responsible for implementation of ESE's quality assurance program as well as assuring adherence to the QAPP. She will be responsible for review of all quality control data generated during the analysis of samples from this project to assure that all analyses meet the data quality objectives established in this QAPP.

2.3.2 ENSECO - California Analytical Laboratory

ENSECO-California Analytical Laboratory, West Sacramento, California is a full service analytical laboratory which will provide services for analysis of dioxins and furans.

M. Miille is the general manager of ENSECO's West Sacramento laboratory and is responsible for the overall operations of the laboratory facilities. S. Eyraud is the Manager of the Low Resolution Dioxin Section and will be the project manager responsible for coordinating with CH2M Hill and ABB-ES. G. Celashi is the manager of Quality Assurance and will be responsible for monitoring the accuracy, validity, and reliability of the data by implementing the laboratory's quality assurance program. Resumes of ENSECO's key personnel at their California facility are included in Attachment C.

3.0 DATA QUALITY OBJECTIVES

The overall quality assurance objective is to ensure that data of known and acceptable quality are produced. Proper execution of each task will yield consistent results that are representative of the media and conditions measured and are useful for meeting the intended project objectives. All data will be calculated and reported in units consistent with those of other agencies and organizations to allow comparability of data bases.

Data quality objectives (DQOs) are statements of the level of uncertainty that a decision maker is willing to accept in results derived from environmental data. DQOs are requirements needed to support decisions relative to the various stages of remedial actions. Throughout the project planning process, DQOs are supplied through qualitative and quantitative statements. These statements are specified in OU-specific documents including work plans, OU FSPs, and QAPjPs.

3.1 Objectives for Air, Water, Soil, Sludge, Sediment, and Waste Analyses

Quality assurance objectives for samples and sample analysis are presented in Table 1-1. (Table 1-1 is located at the conclusion of the text and preceding the attachments to the QAPP). This table has been prepared to provide flexibility in the selection of appropriate methods for each PSC to be evaluated at the Site. The appropriate analytical, geotechnical, and geophysical methods and other associated quality assurance objectives required for a specific PSC are to be selected from Tables 1-1, 3-1, and 3-2.

The DQO statements of the precision, accuracy, and completeness for the QC samples analyzed in Levels D and C have been established by each of the contracted laboratories for each analyte of interest in the soil, water, or air matrices as is appropriate for the analyses they are required to perform. The DQOs for the major analytes to be measured have been summarized in tables presented with each Laboratory QAP in Attachments A, B, C, D, and E.

Table 1-1 presents many methods of analysis which are available for use at a particular OU. Selection of the appropriate methods for any particular OU or PSC will be based on historical data, site observations, and ARARs.

Laboratories will report practical quantitation limits (PQLs) established for the methods presented in the EPA document entitled "Test Methods for Evaluating Solid Waste," SW-846, Third Edition. PQLs, however, are based on method detection limits (MDLs) that have been adjusted to allow for variations in the sample matrix type. Therefore, where possible, Table 1-1 specifies the ideal MDLs published for each method. Since MDLs are governed by the analytical method, and because PQLs are matrix dependent, MDLs are provided to serve as guidance in selecting the appropriate methods to be included in each site specific QAPjP. Specific detection limits, based on the site specific ARARs will be specified in the QAPjP and provided to the selected laboratory prior to the submittal of samples. Laboratory specific method detection limits

and practical quantitation limits are presented with the laboratory generic QAPs in Attachments A, B, C, D, and E.

Instances may occur when the condition of the sample will not permit attainment of the desired detection limits for various parameters, regardless of the selected method, either because of matrix interferences or high analyte concentrations requiring sample dilution. Detection limits for air analyses have been provided in Attachment E. However, since detection limits for air monitoring are dependent on the volume of air sampled, the limits specified may vary.

3.2 Objectives for Field Measurements

3.2.1 Geotechnical Interpretations

Geologic interpretations made during field operations for the collection of geotechnical data will be recorded on Sample/Core Log forms such as shown in Figure 3-1. The purpose of developing geotechnical data is to provide information for the remedial design activities with regard to the soil classification and physical properties of materials present at a PSC as well as to identify profiles of the underlying stratigraphy. To obtain this information, various geotechnical tasks and tests will be performed. Selected samples will be collected of soils for geotechnical testing. The methods of testing are presented in Table 3-1. Soil classification tests will define the types of soils and sediments encountered at a PSC. Moisture content tests will be used in combination with Atterberg Limits determinations to define the effects of compaction of the materials. Particle-size analyses

SAMPLE/CORE LOG

Boring/Well _____ Project/No. _____ Page _____ of _____

Site Location _____ Drilling Started _____ Drilling Completed _____

Total Depth Drilled _____ (feet)

Hole Diameter _____ (inches) Type of Sample/ Coring Device _____

Length and Diameter of Coring Device _____ Sampling Interval _____ feet

Drilling Fluid Used _____ Drilling Method _____

Drilling Contractor _____ Driller _____ Helper _____

Prepared By _____ Hammer Weight _____ Hammer Drop _____ inches

Sample/Core Depth (feet below land surface) From	To	Core Recovery (feet)	Time/Hydraulic Pressure or Blows per 6 inches	Sample/Core Description

Table 3-1. Geotechnical Test Methods for Soil Evaluations

NAME OF TEST	METHOD
Soil Description	ASTM D-2488
Soil Classification	ASTM D-2487
Natural Moisture (Water) Content	ASTM D-2216
Atterberg Limits (Liquid and Plastic Limits)	ASTM D-4318-84
Particle-Size (Grain-Size) Analysis	ASTM D-422-63
Moisture-Density Relationship	ASTM D-698
Falling-Head Permeability with Pressure Chamber (Saturated Sample)	EM 1110-2-1906 USCE App. VII (6)
One-Dimensional Consolidation	ASTM D-2435
Consolidation Consolidation test of undisturbed sample, including loading to overburden pressure, unloading and reloading	ASTM D-4186-82
Sampling by Auger Methods	ASTM D-1452
Thin-Walled Tube Sampling	ASTM D-1587
Maximum and Minimum Density	ASTM D-4254-83
Specific Gravity	ASTM D-854
Organic Content	ASTM D-2974-87
Soil Resistivity/Laboratory	
Soil Corrosivity Index	AWWA/FDOT
Soil pH	ASTM G-51-77
Swell Test of Undisturbed Sample	ASTM D-4546-85
Shear Strength - Unconfined compression Test on Shelby Tube Sample	ASTM D-2166-85
Shear Strength - Triaxial Compression Test - CU/point	ASTM D-4767-88
Compaction and Stabilization:	
Standard or Modified Proctor on Soil	AASHTO T-99 or T-180, 4" mold)
Modified Proctor on Limerock	ASTM D-1557-78
Laboratory LBR or CBR Including Modified Proctor	
Florida Bearing Value	

will be used to evaluate soil porosity and the relative flow characteristics of liquids through the soils. Total organic carbon content will be used to assess the potential of soils to retard the migration of organic contaminants present in the ground water.

3.2.2 Geophysical Measurements

Geophysics comprise a number of fundamental methods used to obtain information about the physical characteristics at a PSC. Data from the geophysical surveys can be used to locate underground storage tanks, product piping and transfer lines, drums, metal debris, and other types of wastes.

Within each method there are usually a number of techniques commonly used and each technique measures specific geophysical characteristics. In addition, every geophysical survey is tailored to each specific target and local geology. Finally, all geophysical methods are subject to noise interference from many sources. Because of all of the above factors, the best quality control is to have a trained geophysicist set up the survey and ascertain that correct data is being collected. Once this is done, quality control for the remainder of a specific survey can be established. The discussions on quality control for geophysical methods are presented in Section 4.2 of the BFSP (Appendix 4.4.2). Table 3-2 lists the geophysical methods that may be employed at a PSC.

Table 3-2. Geophysical Methods

Magnetic
Electromagnetic
Resistivity

3.2.3 Field Analyses

The overall plan for QC based on the type of PSC is presented in Table 3-3. Field analyses that are commonly performed are presented in Table 3-4. The precision, accuracy, and completeness criteria presented in the table are consistent with the criteria established by EPA for the methods referenced.

Analyses of volatile organic compounds in soil and water with a mobile laboratory, or using a Photovac Gas Chromatograph (GC), can provide data with detection limits, precision, and accuracy comparable to laboratory data. However, due to the limited quality control employed in field analyses, the data generated by the field techniques will be considered semi-quantitative. Data generated by these techniques is substantiated by submitting split samples to the contract laboratories for analysis at a frequency to be identified in the QAPjP.

Analytical methodologies, that are modifications of standard EPA methods, will be developed for each field analysis program. The methodology to be used at a specific site will be provided with the QAPjP. The quality control procedures that will be used are described in the standard operating procedures presented in Attachment G.

Appropriate uses of field measured VOCs using field portable GC techniques include:

1) Analysis of effluent streams with unknown or highly variable concentrations,

Table 3-3. Overall Plan for QC Based on Type of Site

DQO Levels[1]	Type of Site	QC Requirements						
D	NPL Level D	PE Sample	Laboratory[2] Audit	QA Plan Review	Use CLP Procedures	Monthly Review	10% field Duplicates Report	CLP Validation
C	Major Non-NPL Level C	PE Sample	Laboratory[2] Audit	QA Plan Review	Use EPA-Approved Method[3]	Monthly Review	10% Field Duplicates	Review of Final Data

[1] QC criteria for Data Quality Objective Levels.
[2] All laboratory audits will be performed by the NCR.
[3] Includes methods from SW 846, American Society for Testing Materials, and Federal Register.

CLP = Contract laboratory protocol
PE = Performance evaluation samples
DQO = Data quality objective

TF533\QAPP\WAS3-3.W51

Table 3-4. QA Frequency and Objectives for Field Measurements

Parameter	Analyses Method	Precision	Accuracy (Recovery)	Completeness %
pH	150.1	0.05 units	±0.2 units	95
Conductivity	120.1	7.6 umhos/cm	±2%	95
Temperature	170.1	0.1°C	±0.2°C	95
Volatile Organic Halocarbons (VOHs)	8021M[1/]	30% RPD	±40%	90
and Aromatics (WAs)	8020[1/]	30% RPD	±30%	90

QA Sample Frequency Analysis	Initial Calibration	Calibration Check	Matrix Reagent Blank	Matrix Spike	Spike Duplicate
pH	Daily	Every 4 hrs	----	----	----
Cond.	Daily	Every 4 hrs	----	----	----
VOHs[1/]	Weekly[2/]	Daily	Daily	5%	5%

VOAs[1/]	Reagent Water Spike	Reagent Water Spike Duplicate	Sample Duplicate
pH	----	----	Daily
Cond.	----	----	Daily
VOHs	As Needed[3/]	As Needed[3/]	5%

1/ Method 8021M is a modified EPA Method 8021. The modification includes the substitution of a Flame Ionization Detector for the specified Electrolytic Conductivity Detector. All results for VOHs performed in the field will only be considered estimated or qualitative values. All samples analyzed for VOHs in the field will also be analyzed for VOHs by a laboratory using a gas chromatography method employing a Hall (Electrolytic Conductivity) detector to obtain optimum sensitivity. Method 8020 will employ a photoionization detector (PID) for detecting the aromatic compounds. All results for VOAs performed in the field will be considered semi-quantitative.

2/ An initial calibration will be run at the beginning of each week. If the continuing calibration check sample exceeds ±15% of the expected value, a new initial calibration is performed.

3/ A reagent water spike and spike duplicate is analyzed only if the matrix spike or matrix spike duplicae are not in control.

2) Head space analysis of drummed waste,

3) Analyses of soil or ground water to determine the areal extent of constituents of interest prior to installation of permanent monitor wells and/or submission of samples to contract laboratories,

4) Analysis of air samples to provide real time monitoring data during excavations, and

5) Analysis of soil or ground water during deep well installation to determine well screen intervals.

3.2.4 Water-Level Measurements

The measurement of water levels is a critical aspect of any ground-water investigation. Water level measurements are required during the course of the investigation to confirm the ground-water flow direction.

Water levels will be measured by sampling team personnel during all sampling events. Water levels are measured with a chalked tape or an electronic measuring device, in accordance with standard operating procedures published by EPA Region IV (Attachment H) and described in Sections 4.5.2 and 4.13.5 of the BFSP (Appendix 4.4.2). All water level measurements will be recorded to the nearest one one-hundredth of a foot. Using the survey described in Section 3.2.4.4 of the Basic Site Work Plan, all water level data will be referenced to mean sea level.

4.0 SAMPLING PROCEDURES

The quality of the data collected in an environmental study depends on the quality of the sampling activities. Therefore, field operations will be carefully planned and implemented. Detailed procedures and protocols for site selection, sample collection, handling, preservation, shipping and storage are described in detail in the following sections.

4.1 General Sampling Procedures

The sampling plan that will be followed at each OU will be provided in the OU FSP. Sampling for ground water, surface water, soil/sediment, and solid wastes will be accomplished in accordance with protocols described in Section 4 of the EPA Region IV Standard Operating Procedures/Quality Assurance Manual (SOP/QAM) (Attachment H). Ambient air sampling will be conducted in accordance with established NIOSH protocols as outlined in "NIOSH Manual of Analytical Methods, Third Edition, 1984", and EPA procedures specified in the "Third Edition of Test Methods for Evaluating Solid Waste, 1986", the "Compendium of Methods for the Determination of Toxic Organics in Ambient Air, 1984", and the EPA Draft Contract Laboratory Program Statement of Work for the Analysis of Ambient Air Samples.

4.1.1 Types of Samples

Samples collected for laboratory analysis may consist of sediments from streams, swamps, and lakes and rivers; soil samples from soil borings and surface soils; ground water from monitoring wells; soil gas; surface water; solid waste samples from test pit

excavations; and air samples from disposal areas and background locations as well as during test pit excavations. The number of samples of each matrix to be collected for each parameter, and the number of pertinent field QC samples required to be submitted for each parameter will be determined prior to each field investigation and presented in the OU FSP and the QAPjP.

4.1.2 Sample Containers

Sample containers utilized for the collection of all samples will be new, pre-cleaned, and pre-baked according to the procedures specified in the analytical methods. U.S. Army Corps of Engineers guidelines have been adopted concerning the handling procedures for environmental samples containing varying degrees of contaminants. The three levels of contamination have been defined as follows:

1) Low level samples are considered to be those collected off-site, around the perimeter of a waste site, or in areas where hazards are thought to be significantly reduced by normal environmental dilution, attenuation, and degradation processes.

2) Medium level samples are commonly those collected in areas of moderate dilution by normal environmental processes.

3) High level samples include those in drums, surface impoundments, direct discharges, and chemical spills where there is little or no evidence of environmental dilution. High level samples are suspected to contain

greater than 15% concentration of any individual chemical constituent.

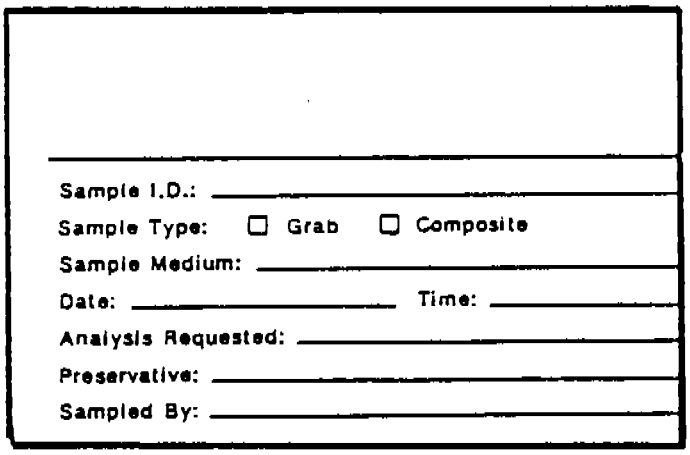
It is anticipated that the majority of samples collected for this investigation will be classified as low level samples. However, soils and wastes collected from soil borings and test pits may require classification as medium or high level samples.

Table 1-1 (End of Report) summarizes the sample containers, handling, and preservation procedures required for each type of sample or parameter. Sample containers will be kept closed and in the cooler until use.

Containers for geotechnical samples may be undisturbed sample tubes or soil sampling jars provided by the contracted soils laboratory. The type of soil sample containers employed will be in accordance with the requirements established for the geotechnical analysis methods presented in Attachment F.

4.1.3 Sample Labels and Sampling Logs

Samples collected for chemical analysis will be fully labeled at the time of collection. At a minimum, the sample label information will include the sample identification, the date and time of collection, sample matrix, the analyses requested, the preservatives used, and the initials of the personnel collecting the sample. An example of a sample label is shown in Figure 4-1. Sample collection data, including information contained on the labels, will be recorded in the bound field log book as the samples are collected. All recorded entries will be made in indelible ink.



SAMPLE LABEL

FIGURE 4-1

No erasures will be made. If an error is made, a correction may be made by drawing a line through the error, initialing the error, and starting a new entry on the next line. Sample containers will be placed on ice in coolers immediately after sampling.

A soil/sediment sampling log as presented in Figure 4-2 will be completed for the collection of every soil, sediment, and solid waste sample. A water sampling log similar to the one presented as Figure 4-3 will be completed during the collection of ground-water and surface-water samples. An air sampling data sheet similar to Figure 4-4 will be completed for each air sample collected. These logs will be completed as samples are collected. Field QC samples will be clearly identified on the appropriate field sampling log and in the field log book.

4.1.4 Equipment Cleaning

Sampling equipment cleaning procedures (pre- and post-sampling) will be conducted in accordance with procedures specified in the EPA Region IV SOP/QAM presented in Attachment H of the QAPP. The cleaning procedures specified in this section are to be used by all sampling personnel to decontaminate sampling and other field equipment prior to field use. The specific cleaning materials and procedures for equipment decontamination are presented in the following paragraphs.

(a) Laboratory Detergent and Cleaning Solvent. The laboratory detergent used for equipment decontamination will be a standard brand of phosphate-free laboratory detergent such as Alquinox®, Liquinox®, or Micro®. The standard cleaning solvent shall be pesticide-grade isopropanol. The use of any other

SOIL/SEDIMENT SAMPLING LOG

Project No. _____ Page ____ of ____

Site Location _____

Sample ID No. _____ Coded/Replicate No. _____

Date _____ Time of Sampling: Begin _____ End _____

Weather _____

Site Description _____

_____

_____

SAMPLING DATA

Collection Method _____

Depth _____ Moisture Content _____ pH ____

Color _____ Odor _____

Description _____

_____

_____

Analyses Required	Container
_____	_____
_____	_____
_____	_____
_____	_____

Sample Monitoring (TIP, OVA, HNU, etc.) _____

_____

_____

Remarks _____

_____

Sampler(s) _____

SOIL/SEDIMENT SAMPLING LOG

FIGUR 4-2

REMEDIAL INVESTIGATION/
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WATER SAMPLING LOG

Project/No. _____ Page _____ of _____

Site Location _____

Site/Well No. _____ Coded/ Replicate No. _____ Date _____

Weather _____ Time Sampling Began _____ Time Sampling Completed _____

EVACUATION DATA

Description of Measuring Point (MP) _____

Height of MP Above/Below Land Surface _____ MP Elevation _____

Total Sounded Depth of Well Below MP _____ Water-Level Elevation _____

Held _____ Depth to Water Below MP _____ Diameter of Casing _____

Wet _____ Water Column in Well _____ Gallons Pumped/Bailed Prior to Sampling _____

Gallons per Foot _____

Gallons in Well _____ Sampling Pump Intake Setting (Feet below land surface) _____

Evacuation Method _____

SAMPLING DATA/FIELD PARAMETERS

Color _____ Odor _____ Appearance _____ Temperature _____ °F/°C

Other (specific ion; OVA; HNU; etc.) _____

Specific Conductance, umhos/cm _____ pH _____

Sampling Method and Material _____

Constituents Sampled	Container Description From Lab ____ or G&M ____	Preservative

Remarks _____

Sampling Personnel _____

WELL CASING VOLUMES

GAL/FT				
	1-¼" = 0.077	2" = 0.16	3" = 0.37	4" = 0.65
	1-½" = 0.10	2-½" = 0.24	3-½" = 0.50	6" = 1.46

WATER SAMPLING LOG

FIGURE 4-3

AIR SAMPLING LOG
(One Sample Per Data Sheet)

PROJECT: _____ DATE SAMPLED: _____
SITE: _____ TIME SAMPLED: _____
PSC NO: _____ OPERATOR: _____
LOCATION: _____ WEATHER: _____

SAMPLING DATA

SAMPLE NUMBER: _____ SAMPLER TYPE: _____

PARAMETERS OF INTEREST		METHOD OF ANALYSIS
VOLATILES	: _____	Tenax Adsorbent Tube with GC/MS
SEMI-VOLATILES	: _____	Filter/PUF/XAD-2 with GC/MS
PESTICIDES/PCBs	: _____	Filter/PUF/XAD-2 with GC/MS
METALS	: _____	Filter with ICP or GFAA

PUMP SERIAL NO. _____ CALIBRATED BY: _____

START TIME: _____ STOP TIME: _____

	Time	Dry Gas Meter Reading	Rotameter Reading	Flow Rate, *Q ml/min	Ambient Temp.	Barom. Pressure mm/Hg	Rel. Humid. %
1.							
2.							
3.							
4.							
5.							

Comments: _____

Total Volume Data ***

V = (Final - Initial) Dry Gas Meter Reading, or = ____liters

$= \frac{Q_1 + Q_2 + Q_3 \ldots Q_n}{N} \times \frac{1}{1000 \times (\text{Sampling time in minutes})}$ = ____liters

* Flowrate from rotameter or soap bubble calibrator (specify which)

* * Use data from dry gas meter if available

09/misc/datasht.red

AIR SAMPLING LOG

FIGURE 4-4

REMEDIAL INVESTIGATION
FEASIBILITY STUDY
QUALITY ASSURANCE
PROGRAM PLAN

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detergent or solvent must be approved by the ABB-ES QA Officer and the U.S. Navy, and its use must be documented in the field log books.

(b) Cleaning Water. Tap water from any municipal water supply may be used for initial equipment rinses and steam cleaning prior to decontamination. The use of an untreated potable water supply is not an acceptable substitute for tap water (EPA, Region IV, 1991).

Deionized/organic-free, (ASTM Type II) water will be used during cleaning procedures for field equipment after tap water rinses. Deionized/organic-free water is defined as tap water that has been treated with activated carbon and deionizing units. Deionized/ organic-free water should contain no metals, inorganics, pesticides, herbicides, extractable organic compounds, and less than detection units of purgeable organic compounds as measured by appropriate analysis of field and equipment blanks submitted with samples.

Deionized/organic free water will be used to prepare soap solutions and for final rinses during field equipment cleaning. The solvents, laboratory detergent, and rinse waters used to clean equipment shall not be reused.

(c) Location of Decontamination Process. When possible, equipment will be decontaminated in batches at a central staging area. Solutions, rinse solvents, and deionized water will be disposed in the Facility sanitary sewer system. Decontamination of soil and sediment sampling equipment as well as water sampling equipment will be conducted at a designated location within each

PSC. Small volumes of waste solutions, solvents, and rinses generated at the sampling sites during equipment decontamination will be collected over 6- or 8-ml plastic sheeting and allowed to evaporate.

4.1.4.1 General Decontamination Procedures. All non-dedicated sampling equipment (bailers, Kemmerer-type samplers, glass bowls, split spoon, stainless steel scoops, spoons, augers, etc.) will be decontaminated using the following procedure.

1. Rinse equipment thoroughly with potable tap water or deionized/distilled water in the field as soon as possible after use.

2. Wash equipment thoroughly with laboratory detergent and deionized/organic-free water using a brush to remove any particulate matter or surface film;

3. Rinse equipment thoroughly with deionized/organic-free water;

4. Rinse equipment with isopropanol alcohol;

5. Rinse equipment thoroughly with deionized/organic-free water;

6. Allow equipment to air dry; and

7. Wrap equipment completely with aluminum foil to prevent contamination during storage and/or transport to the field.

4.1.4.2 Equipment Storage. All decontaminated field and sampling equipment will be stored in covered containers or wrapped in aluminum foil to minimize contamination. Decontaminated equipment shall be clearly identified by labeling the wrapping material. Field equipment and reusable sample containers needing cleaning or repairs shall not be stored with clean equipment. Field sampling equipment that needs to be repaired shall be clearly identified and the repairs shall be documented.

4.1.4.3 Procedures for Cleaning Equipment. The effectiveness of field cleaning procedures shall be monitored by collection of equipment blanks. Equipment blanks will be prepared according to the procedures specified in Section 8.0 of this QAPP. The equipment blank is collected in the same type of sample bottle as the field samples, preserved in the same manner, and analyzed for all parameters of interest. Equipment blanks will be collected during each day of sampling and analyzed for all parameters at a minimum frequency of one per 20 samples. It should be noted that contamination detected in equipment blanks may be due to factors other than poor decontamination techniques. Other sources of potential contamination include the chemical preservatives and the sample bottles used during the investigations as well as laboratory sample handling procedures. Quality control samples (field blanks) will be collected to help evaluate these sources of potential contamination.

4.2 Sampling Preparation Procedures

Prior to initiating each sampling event, the senior member of the field team will assure that the team members have available the appropriate equipment and documents to complete the task. In addition, the senior member will notify the On-Site IR Manager of the sampling schedule at least five days prior to sampling. Upon arrival at the Site, the field team will check in with the On-Site IR Manager, confirm any access restrictions, and, if necessary, obtain keys for access to the PSC and the monitor wells.

The Contractor QAO will contact the appropriate contract laboratories one to two weeks prior to sample collection to obtain bottles and schedule the analyses. During sampling, the senior member of the sampling team will contact the QAO or the laboratory manager at least every other day to confirm sample collection and shipments. In the event samples are to be shipped on a Friday, the QAO will notify the laboratory that a shipment will be delivered Saturday.

4.2.1 Sampling Procedure Documentation

Prior to departure for the sampling location each member of the field team will have become familiar with, and have access to, the following documents:

1) The Quality Assurance Program Plan (QAPP);

2) The Basic Field Sampling and Analysis Plan (BFSP);

3) The OU-Specific Quality Assurance Project Plan (QAPjP);

4) The OU-Specific Sampling Plan (OU FSP); and

5) The EPA Region IV SOP/QAM.

4.2.2 Sampling Equipment and Materials

Prior to the sampling event, the field personnel will prepare for field sampling/air monitoring by stocking the sampling vans with the items listed below (as needed).

1) Site map, names of contacts, and access keys to monitor wells, gates, etc.;

2) Water sampling logs, sample core logs, soil/sediment sampling logs, air sampling logs, chain-of-custody forms, sample labels, waterproof-ink pen, and tape;

3) Sample containers (check for proper number, type, and preservatives), coolers, and ice;

4) Cooler Custody seals;

5) Water level measurement equipment (150 ft steel tape with weight electronic tape);

6) Well purging equipment (peristaltic pumps, 2-inch diameter submersible pumps);

7) Water sampling equipment (Teflon™ bailers, Kemmerer-type samplers, peristaltic pumps);

8) Filtering equipment (in-line filter stand, glass fiber per-filter, 0.45 micron membrane filter);

9) Soil/sediment sampling equipment (stainless-steel hand auger, stainless-steel spoons, bowls, etc.);

10) Air sampling equipment (pumps, filters, solid sorbent, carbon tubes);

11) Power source;

12) Field analysis (pH, temperature, conductivity) instruments and calibration standards;

13) Teflon coated stainless steel cable or disposable nylon rope, knife, and miscellaneous tools;

14) Disposable vinyl gloves;

15) Appropriate Safety and Health equipment and dress;

16) Decontamination equipment and supplies (laboratory-grade detergent, deionized/organic-free water, pesticide-grade isopropanol, buckets, scrub brushes, plastic sheeting and aluminum foil)

17) Five-gallon graduated bucket;

18) Laboratory wipes and Ziploc bags; and

19) Plastic sheeting and folding table or saw horse.

All equipment must be checked for proper operation. Equipment that will come in contact with the samples must be properly decontaminated before use. Upon arrival at each sampling location, sampling personnel will clear the area around the sample site of obstructions and possible sources of contamination. Plastic sheeting and a folding table will be placed next to the sampling location to provide a work area that minimizes sample contamination.

4.3 Sample Collection Procedures

All sample collection procedures for air, water, soils, sludges, and waste are described in Section 4.0 of the BFSP (Appendix 4.4.2). Required specific sampling techniques not described in the BFSP will be described in the OU FSP.

At some PSCs total cyanide may be a required analyte. In order to meet EPA method requirements for collection of aqueous samples for cyanide analysis, the spot tests for sulfide and oxidizing agents, as presented in Attachment I, should be performed in the field prior to preservation of the sample with sodium hydroxide. Sulfide and oxidizing agents (e.g., chlorine) are interferences in the measurement of cyanide in aqueous samples. Samples screened positive for sulfide and oxidizing agents will be

shipped immediately to the laboratory for treatment and subsequent analysis.

4.4 Geotechnical Sampling

Geotechnical sampling will be performed in accordance with ASTM methods and EPA Compendium identified in Table 3-1. Geotechnical samples shall be sealed, shipped, and stored in accordance with the following procedures.

4.4.1 Disturbed Soil Samples

Disturbed soil samples shall be properly labeled and placed in sealable containers. Samples shall then be placed in appropriate containers, such as cardboard boxes. Only borings from one location shall be placed in a shipping container. The containers shall be taped shut in the field and labeled to show the project name and number, identification of sample location contained in the box, total depth interval of the samples, and other information as required by the on-site geologist or engineer.

If the samples are to be temporarily stored at the Site, they shall be protected from the weather, including excessive heat. Indoor storage shall be employed, where possible. For commercial shipment, the containers should be marked "keep from heat and freezing". Samples shipped or hand carried to the geotechnical laboratory shall be accompanied by a chain-of-custody and laboratory log form providing a record of the samples.

4.4.2 Undisturbed Soil Samples

Upon recovery of an undisturbed sample, at least one-half inch of soil shall be cleaned from each end of the tube and the ends of the soil sample squared off. Usually, the tip of the sample will contain drill cuttings and these must be removed prior to sealing. The in-situ soil which has been cleaned from the tube can be used to give a visual classification for the sample. Under certain circumstances such as excessively moist samples, a tube may be allowed to drain prior to the sealing process.

To seal the tube, the resulting space at each end shall be filled with a hot paraffin wax or equivalent melted sealing material or with expandable packers as approved by the on-site geologist or engineer. As an alternate for tubes containing partial samples, after sealing the ends of the sample (using approximately one inch of melted sealing material), a dry, clean filler, sand, etc., can be placed in the void areas before sealing. The filler prevents the sample from breaking the end seals during handling and shipment. The ends of the tube then shall be closed with tight-fitting metal or plastic caps and the seam, between the cap and tube, wrapped with tape. Finally, the ends of the tube shall be dipped in hot wax, beyond the tape, as a final sealing measure.

Preferably the tubes shall be hand carried to the geotechnical laboratory in a vertical position to maintain an in-situ orientation and shall be marked with a "way-up" arrow, using an indelible marker. If the tubes are being transported via airplane, they shall be carried on to the plane and not checked as baggage. If the tubes are to be transported by truck or automobile, they shall

be padded carefully and wedged in place to prevent movement (e.g., through use of a tube rack). If tubes must be shipped as freight, they shall be packed in secure wooden boxes which have dividers built in to prevent movement of the tubes, or the boxes shall be tightly filled with packing material such as wood chips, paper, etc., to prevent movement. The boxes should be marked "fragile" and "keep from heat and freezing". All packaging of tubes for shipment will be directed by the on-site geologist or engineer.

5.0 SAMPLE CUSTODY

Sample custody is a vital aspect of remedial action programs as well as ground-water monitoring studies because these type of programs generate data that may be used as evidence in a court of law. The samples must be traceable from the time of sample collection until the time the data are introduced as evidence in enforcement proceedings.

5.1 Field Record Log Book

The key aspect of documenting sample custody is through record keeping. A bound field log book with sequentially numbered pages will be maintained during the source of the field work to document the collection of every sample. In addition, logs for sample/core (geologic logs), well completion, soil/sediment, water sampling, and air sampling, previously described in Section 4.0, will be filled out for each well drilled and each sample collected. All loose-leaf log sheets will be arranged in sequential order and bound together upon completion of each sampling event. All documents will be completed in ink, dated, and signed by the field person conducting the work.

5.2 Sample Labeling

Sample containers will be labeled at the time of sampling with the information specified in Section 4.1.3. An example of a typical sample label is presented in Figure 4-1. At the time of sampling the identification assigned to each sample will be recorded on the appropriate sample log form (Figures 4-2, 4-3, and 4-4). After each bottle is filled and before it is placed in

storage, the sampler will initial the label to document proper sample handling. The sample numbering system incorporates identifiers for the PSC, sample matrix, and the sample location. The identification system has been designed to give reference to previously existing sample location identification numbers. The identification number will consist of a facility code, PSC code for both new and old PSC numbers, date code, sample matrix code, and sample number. Each of these codes is described below and also in Section 3.0 of the BFSP (Appendix 4.4.2).

Site Code. The Site code for all samples will be "J" for Naval Air Station, Jacksonville, Florida (Nas.Jax).

PSC Code. The PSC code is a location code. This code will be a number, e.g., 25.

Date Code. The data code will consist of a four digit number. The first two digits refer to the month and the last two digits refer to the year.

Sample Matrix Code. This code includes Field QC Samples. The sample matrix code will be a two letter (alpha) code that describes the type of sample matrix. The following codes will be used:

- Soil: SL
- Sediment: SD
- Surface Water: SW
- Ground Water (Dug in pit, trench, etc.): GW
- Ground Water (Monitor Well): MW
- Potable Water: PW
- Ambient Air: AA

- Waste, Sludge, Landfills, Waste Piles: SM
- Field Blank (Water) FB
- Equipment Rinsate Blank: EB
- Trip Blank: TB
- Background (Soil): BS
- Background (Surface Water Upstream): BU
- Background (Ground Water): BG
- Replicate RP

Sample Number Code. The sample number code will be a three digit number starting with 001; and proceeding sequentially 002, 003, etc. This allows for potentially 999 samples from any matrix, although unlikely to occur, at any site.

Sample Sequence Code. The sample sequence code will be a single digit letter starting with A and proceeding sequentially B, C, etc. The sample sequence code is used for samples collected at multiple depths at the same sample location will be assigned sequentially with depth. If only one depth is sampled during a sample event then the sample sequence number will not be used.

Examples. The following numbers are provided as examples to illustrate how the sample coding will work for each matrix. Assume the samples were collected from PSC number 25 and also from PSC 56. Samples were collected in October of 1990.

Soil Samples:
PSC 25: J261090SL005
PSC 56: J561090SL009

Sediment Samples:
PSC 25: J251090SD012
PSC 56: J561090SD048

Surface Water Samples:
PSC 25: J251090SW015

Ground Water Samples: (dug)
PSC 25: J251090GW028

Monitor Well Ground-Water Samples:
PSC 25: J251090MW152

Ambient Air Samples:
PSC 56: J561090AA023

Field QC Samples:
PSC 25: Field Blanks: J251090FB004
Equipment Blanks: J251090EB005

5.3 Sample Container Custody

All sample containers to be provided by the subcontract laboratories for this project will be prepared as described in Section 4.0. All containers will be shipped from the laboratory to the designated location by common carrier in sealed coolers. The laboratory will include a shipping form listing all containers shipped and the purpose of each container. This list will become part of the chain-of-custody record.

5.4 Sample Custody, Shipment, and Laboratory Receipt

For the purpose of this discussion, samples are considered in custody if the following conditions are not violated:

1) The responsible person maintains possession;

2) After the samples are received, they remain in the view of, or in the physical possession of, responsible persons;

3) Samples are sealed/locked so that no one can tamper with them; or

4) Samples are maintained in a secured area, restricted from authorized personnel.

The field samples can be classified into two categories: (a) field measurements, and (b) laboratory analyses.

5.4.1 Field Measurements

Field measurements are made immediately after the sample has been collected. The data will be recorded directly in bound field logbooks along with identifying information on sampling conditions and location. Field measurements include the following: pH, temperature, dissolved oxygen, conductivity, salinity, turbidity, soil vapor surveys, and portable field gas chromatography analyses. Custody of samples collected for analysis on-site will be transferred directly to the mobile laboratory personnel.

5.4.2 Laboratory Measurements

These measurements refer to samples collected and preserved in the field and shipped to the appropriate laboratory for chemical analysis. Identifying information on sampling conditions and location will be recorded as indicated above, together with a record of the required analyses for each of the samples collected.

All samples will be maintained in the custody of the sampling personnel. At the end of each sampling day and prior to the transfer of the samples off-site, chain-of-custody entries will be made for all samples using the standard chain-of-custody form illustrated in Figure 5-1. All information on the chain-of-custody form and the sample container labels will be checked against the sample field log entries and samples will be recounted before leaving the sampling site. Upon transfer of custody, the chain-of-custody form will be signed and dated by the sample team leader. Because common carriers (Federal Express, Purolator Courier, etc.) will not sign chain-of-custody forms, the forms will be placed in the cooler prior to shipping.

A signed, dated, custody seal (Figure 5-2) will be placed over the lid opening of the sample cooler to indicate if the cooler has been opened during shipment prior to receipt by the laboratory. All chain-of-custody forms sent to the laboratory must be signed and dated by the senior staff member assigned to the field team.

Upon receipt of the samples at the laboratory, the laboratory sample custodian will note the condition of each sample received as well as any questions or observations concerning sample integrity. The laboratory sample custodian also will maintain a sample tracking record that will follow each sample through all stages of laboratory processing. The sample tracking records will document sample removal from storage as well as the date of sample extraction or preparation, and sample analysis. These records will

CHAIN-OF-CUSTODY RECORD

Page ______ of ______

Location: ____________________

Laboratory: ____________________

Project/Number ____________________

Shipping Container ID: ____________________

Sampler(s) ____________________

____

SAMPLE CONTAINER DESCRIPTION

SAMPLE IDENTITY	Date Sampled												Total	Remarks

Total No. of Containers ______

SAMPLE

Relinquished by: ____________________ Organization: ____________________ Received by: ____________________ Organization: ____________________

Date: __________ Time: __________ Date: __________ Time: __________

Relinquished by: ____________________ Organization: ____________________ Received by: ____________________ Organization: ____________________

Date: __________ Time: __________ Date: __________ Time: __________

Relinquished by: ____________________ Organization: ____________________ Received by: ____________________ Organization: ____________________

Date: __________ Time: __________ Date: __________ Time: __________

Delivery Method: ____________________ (attach shipping bill, if any)

(Use extra sheets, if necessary)

CHAIN-OF-CUSTODY RECORD

FIGURE 5-1

SOUTHERN DIVISION NAVAL FACILITIES ENGINEERING COMMAND

REMEDIAL INVESTIGATION/
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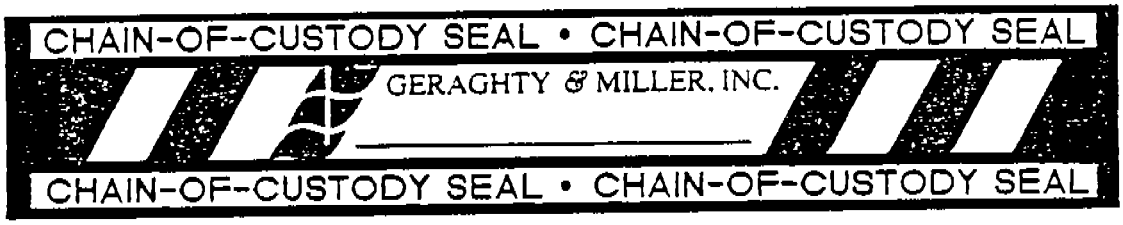

CHAIN-OF-CUSTODY SEAL

FIGURE 5-2

REMEDIAL INVESTIGATION/
FEASIBILITY STUDY
QUALITY ASSURANCE
PROGRAM PLAN

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be used to determine compliance with handling and holding time requirements. Samples will be stored by the laboratory in their original containers in walk-in refrigerators designated by the contracted laboratories. Specific chain-of-custody procedures used by the commercial laboratories contracted for this project are included in their respective quality assurance plans presented in Attachments A through E.

6.0 CALIBRATION PROCEDURES AND FREQUENCY

The calibration procedures and calibration frequency employed by the contracted laboratories will be in accordance with the analytical procedures listed in Table 1-1 of this QAPP. Calibration of field equipment, such as pH meters and specific conductance meters, will be performed according to the procedures described in Attachment D of the EPA SOP/QAM referenced in Attachment H of this document. Calibration procedures for field instruments used by the Contractor are summarized in the Equipment Maintenance and Calibration Procedures presented in Attachment G of this QAPP. Other field equipment used for analyzing samples in the field or conducting geophysical surveys, that are not described in the EPA SOP/QAM or in Attachment G will be calibrated and operated in accordance with the manufacturer's recommendations.

7.0 ANALYTICAL PROCEDURES

7.1 Laboratory Analytical Procedures

The analytical procedures used during the implementation of the work plan are listed in Table 1-1. Analysis of samples collected by the Contractor will be performed by selected contracted laboratories in accordance with protocols and QA procedures established by the EPA. QC requirements for Levels D and C are described in Section 8.0.

7.2 Field Analytical Procedures

Conductivity, salinity, pH, dissolved oxygen, and temperature will be measured in the field according to EPA methods referenced in the EPA SOP/QAM in Attachment H of the QAPP and instrument manufacturers instructions.

8.0 INTERNAL QUALITY CONTROL CHECKS

Internal quality control (QC) checks are those procedures used during all phases of the work that are designed to control the individual processes involved in data generating activities. Internal QC checks of sampling procedures and laboratory analyses will be conducted periodically throughout the investigation at pre-determined intervals. The following discussion describes the required QC checks to be performed for both the field and laboratory activities at both DQO levels (Level D and Level C).

8.1 Internal Field Sampling Quality Control Checks

Internal QC checks for general field sampling (field QC samples) will consist of the preparation and submittal of equipment blanks, field blanks, trip (travel) blanks, and field replicates (field duplicates), and field splits (referee duplicates) for analysis of selected parameters of concern at frequencies described in Table 8-1. The blanks, duplicates, and referee samples are defined and explained in Section 8.1.1 through 8.1.5.

Although the number of QC samples changes, the types of field QC samples remain the same regardless of the level of QC implemented. Table 8-1 lists the percentage of field QC samples per level per sample matrix. A sampling event is considered to be from the time the sampling personnel arrive at the site until these personnel leave for more than a day. An example of two events would be if sampling personnel went to a PSC for three weeks, drilled borings, and installed ground-water wells. During this visit, soil and water samples were collected. The sampling crew

Table 8-1. Field QC Samples per Sampling Event

Type of Sample	Level C		Level D	
	Metal	Organic	Metal	Organic
Trip Blank (for VOAs only)	NA[1/]	1/cooler	NA[1/]	1/cooler
Equipment Rinsate[2/]	1/day	1/day	1/day	1/day
Field Blank	1/source/event		1/20	1/20
Field Replicates[3/]	10%	10%	10%	10%
Referee Duplicate[3/]	To be determined[4/]			

1/ NA = Not applicable

2/ Samples are collected daily; however, only samples from every other day are analyzed. Other samples are held and analyzed only if evidence of contamination exists.

3/ The duplicates must be taken from the same sample which will become the laboratory matrix/matrix spike duplicate for organics or for the sample used as a laboratory duplicate in inorganic analysis.

4/ The requirement for split samples has not been defined. If referee duplicates are required for any PSC or site they will be described in the site specific QAPjP and SSFSP.

5/ At a minimum, one sample for each water source for a given sampling event shall be collected for analyses.

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left the PSC for two months, thus concluding the first sampling event. The crew later returned to collect another set of groundwater samples over a three-day period. The second visit would constitute the second sampling event.

8.1.1 Equipment Blank

Equipment blanks (rinsates) are the final analyte-free water rinse from equipment cleaning, collected daily during a sampling event. An equipment blank is made by pouring organic-free/deionized water into or over the field sampling apparatus (bailer, pump tubing, etc.) that conceivably could be a source of contamination. The water is then sealed in the same type of sample bottle as the other samples, preserved in the same manner (using the exact preservative source), transported to the laboratory with the samples, and analyzed for the same parameters of interest. Equipment rinsates should be prepared and submitted at a frequency of one per day for all levels of QC. Initially, rinsate samples from every other day should be analyzed. If analytes pertinent to the project are found in the rinsate, the remaining rinsate samples must be analyzed. The results from the blanks will be used to flag or assess the levels of analytes in the samples. This comparison is made during data validation. The rinsates are analyzed for the same parameters as the related samples.

8.1.2 Field Blanks

Field blanks consist of the source water used in decontamination and source water used in steam cleaning. A field blank consists of sample containers filled in the field with organic-free/deionized water prepared and preserved in the same manner as

the samples. The field blanks are analyzed along with the field samples for the constituents of interest to check for contamination imparted to the samples by the sample container or other exogenous sources. At a minimum, one field blank from each event and each source of water must be collected and analyzed for the same parameters as the related samples. For this project, a field blank will be collected at each PSC for all parameters analyzed at a frequency of 1 per water source per 20 samples for Level D and 1 per water source per sampling event for Level C.

8.1.3 Trip Blank

Trip blanks are defined as samples which originate from organic free (analyte free), deionized water taken from the laboratory that travels unopened with the sample bottles to the sampling site and returned to the laboratory with the volatile organic (VOC) samples. One trip blank should accompany each cooler containing VOCs, should be stored at the laboratory with the samples, and analyzed by the laboratory. Trip blanks are only analyzed for VOCs.

8.1.4 Field Replicates (Duplicates)

A field replicate is a duplicate sample prepared at the sampling location from equal portions of all sample aliquots combined to make the sample. Both the field replicate and the sample are collected at the same time, in the same container type, preserved in the same way, and analyzed by the same laboratory as a measure of sampling and analytical precision.

Field replicates for soil samples are collected, homogenized, and split. All samples except VOCs are homogenized and split. Samples collected for VOC analyses will be immediately placed in the appropriate containers.

The field replicates for water samples are collected simultaneously as described above. Field replicates should be collected at a frequency of 10 percent per sample matrix for Levels D and C. All the field replicates should be sent to the same laboratory responsible for analysis. The identification of field replicates should be disguised so the laboratory will not know a test of precision is being conducted. A record of the disguised replicate identification should be maintained on the sample log and in the field log book. The same samples used for field replicates may be split by the laboratory and be used as the laboratory replicate or matrix spike. This means that for the field replicate sample, there will be analyses of the normal sample, the field replicate, and the laboratory matrix spike/matrix spike duplicate or laboratory duplicate.

8.1.5 Field Split (Referee Duplicates)

A field split or referee duplicate is a duplicate sample prepared at the sampling location from equal portions of all sample aliquots combined to make the sample. Both the field split and the sample are collected at the same time, in the same container type, and preserved in the same fashion. The split sample and split of all the equipment blanks and field blanks are submitted to a referee laboratory for analysis to assist in evaluating interlaboratory precision and validating the data.

Field splits shall be sent to the referee QA laboratory (often an EPA designated laboratory) if regulators (state or region) collect split samples or if a special problem occurs in sample analysis or collection. These duplicate samples are collected and analyzed in addition to the field replicates mentioned in the previous section.

8.2 Internal Laboratory Quality Control Checks

Internal laboratory control checks used by the contracted laboratories are described in detail in each method performed. The laboratories will demonstrate the ability to produce acceptable results using the methods requested. The data will be evaluated by the laboratories based on the following criteria (as appropriate for organic and inorganic chemical analyses) established for Levels D and C described in the NEESA 20.2-047B document referenced in Section 1.0. The following are the minimum QC requirements for the laboratory analyses:

8.2.1 Level D

1) Full Contract Laboratory Program (CLP) QC requirements (Most Current Statement of Work)

2) Laboratory must be approved to perform CLP work

3) For methods not defined in the CLP, the following QC requirements must be provided for both organic and inorganic parameters in the data package;

Method blanks
Blank spikes (Reagent Water Spikes)
Matrix spikes (Sample specific)
Matrix spike duplicates (Sample specific)

4) These QC samples are considered deliverables; this does not preclude the standard performances of instrument tuning and calibrations, calibration verifications, interference checks, linearity checks, method of standard additions procedures, surrogate spikes or other QC checks that are considered normal and customary for any requested analysis but will not be reported for the non-CLP methods;

5) Frequency of performance of the above QC samples is one per 20 samples of similar matrix;

6) The batch size for Level D QC is 20 samples;

8.2.2 Level C

1) The laboratory will determine its optimum batch size. The optimum batch size is determined by the number of samples of similar matrix which can be processed simultaneously through the entire preparation and analysis process. For example: if 5 samples can be extracted and 20 analyzed by the instrument, the batch size is 5. Once determined the following QC criteria must be followed:

2) **Method blanks:** A method blank shall be analyzed for all methods with each sample batch and included in the deliverables;

3) **Blank (reagent water) Spikes/Laboratory Control Sample (LCS):** In any method using surrogates spiked into the blanks, the blank shall serve as both the method blank and the blank spike control. In methods not using surrogates (metals, anions, and wet chemicals, a method blank and a blank spike (laboratory control sample) shall be analyzed. Note: For pesticide/PCB methods, surrogates are often used. However, problems have been noted in surrogate recovery for the di-n-butyl-chlorindate typically used. Therefore, for pesticide/PCB analysis, a method blank and blank spike shall be analyzed with each batch as separate samples. A pesticide and/or a PCB shall be used as the spiking compound.

4) **Calibration:** All methods will be calibrated; The following requirements will be observed.

   1) Semi-volatile and volatile analyses by GC/MS, the current CLP calibration method shall be used including frequency requirements, and requirements for System Performance Check Compounds (SPCCs) and Calibration Check Compounds (CCCs).

   2) Other Methods: A minimum of three different concentration standards for each analyte shall be analyzed for initial calibration. The calibration

shall include one standard at a concentration at the method detection limits. The calibration curve shall bracket all samples in the concentration range. Calibration shall be checked every 12 hours of operation and prior to sample analysis. The laboratory shall use the calibration check acceptance criteria specified by the method. If the samples are not within the calibration range, appropriate dilutions of the sample shall be made to bring the samples into the calibration range for quantitation.

Note: The daily calibration acceptance criteria to be used for each method shall be described in each OU-specific QAPjP.

The initial calibration curve shall be plotted and the correlation coefficient and response factors evaluated. The acceptance criteria to be used for the initial calibration curve shall be specified in each laboratory's generic QAP.

5) **Confirmations:** For all GC methods used, second column confirmation shall be used for all positive responses for the analytes of interest.

6) **Surrogate Spikes:** Surrogate spikes shall be performed for all methods for which surrogates are a customary procedure. Surrogate spiking compounds will be consistent with the compounds recommended by the method and/or the EPA CLP protocol.

7) **Matrix spike/matrix spike duplicates** (MS/MSD): For analysis of volatiles, semi-volatiles, and all GC analyses, petroleum hydrocarbons, oil and grease, anions (nitrates, sulfates, chloride, etc.) and other wet chemical methods sample specific MS/MSD are required for every 20 samples of a similar matrix. Similar matrix is defined as either soil or water from the same site. Results of MS/MSD will be reported in the data package.

For metals analysis only, a matrix spike is required for every 20 samples of similar matrix; a matrix spike duplicate may also be performed at the laboratory's discretion in lieu of a laboratory duplicate.

8) **Laboratory duplicates:** For metals and all other inorganic analyses a laboratory (sample) duplicate must be analyzed; a matrix spike duplicate may be used in lieu of a sample duplicate. The frequency for duplicates must be one for every 20 samples of a similar matrix.

9) **Control Charts:** Control charts provide a useful tool in assessing QC efforts and improving processes through graphic displays of a parameter(s) and its variability over time. The parameter plotted on the chart is usually related to control sample testing -- either directly in terms of concentrations or indirectly in terms of derived information such as means of concentrations, ranges of concentrations, percent recovery of spikes, relative percent differences based on duplicate results, or slopes of least-squares data files.

Blank spike controls are required for only the methods and analytes pertinent to the program. The laboratory shall employ a measurement-control program, which, as a minimum, consists of monitoring the results of laboratory preparation and analysis of control samples using statistical control charts. The basis of this program is to demonstrate that the laboratory method for sample preparation and analysis is working properly. This minimum program consists of using the laboratory's distilled and/or deionized water and spiking it with known compounds of interest or elements of interest. By plotting the results of the method blank spike on control charts, a true picture of the actual process of sample analysis is obtained with fewer problems from matrix effects and sample nonhomogenity. This information used in conjunction with matrix spike recoveries, can aid in determining whether an out-of-control condition is due to laboratory problems or matrix problems. Therefore, one batch of control material is the spiked laboratory blank water. The second batch of control material is a soil or sand, This soil can be pulverized and homogenized. If the soil used is known to contain some of the analytes of interest, then no spiking may be required. Additional spiking may be done to an aliquot of control soil just prior to sample preparation. The blank spike water should be analyzed when water samples are analyzed and the blank spike soil should be analyzed alongside soil or waste samples.

The analytes selected for spiking should be representative of the compound class for the organics.

It is suggested that the surrogates used for volatiles and semi-volatiles analyses be used as control analytes for the GC/MS methods. At least two pesticides should be used when pesticide methods are performed and one polychlorinated biphenyl (PCB) when PCBs are analyzed. For wet chemical methods, a single spike of an appropriate control for each method may be used. As an example for cyanide, a control of sodium cyanide from a source other than that used for calibration may be spiked into water and analyzed alongside the water samples. For the metals, it is suggested that at least three of the metals typically analyzed by ICP be monitored and that each element analyzed by furnace or flame atomic absorption be monitored.

9.0 DATA REDUCTION, VALIDATION, AND REPORTING

The use of laboratories will be accomplished by a laboratory services agreement (contract) between Contractor and the laboratory. The contract will specify the scope of services to be performed by the laboratory, the specific analytical quality assurance requirements to be met, and the information to be developed and reported. The Analytical Result Reportables and Data Validation in conjunction with the levels of quality assurance (Level D and Level C) adopted by the Navy and described in the NEESA 20.2-047B document, are referenced in Section 3.0 of this QAPP.

9.1 Data Reduction

As analyses are completed, the digital electronic, or physical data will be reduced and converted into readily usable form in measurement units appropriate for the analysis. All measurements will be reported in appropriate significant figures. Table 9-1 presents the significant figures to be used in reporting analytical data. In this table the Xs signify numbers that are significant and the Os signify numbers that are not significant. The last significant figure reported for any laboratory value is the least accurate and users must be aware of that when using the information supplied.

Table 9-1. Significant Figures Used in Reporting Data

PARAMETER	Sample Type	Units	Range	Significant Figures
Phosphorous	Solids	mg/kg	1-10	X.X
			10-100	XX
			100-1,000	XXX
			1,000-10,000	XXXO
pH	All	S.U.	1-14	X.X
Phenols	Water	µg/L	5-100	XX
			100-1,000	XXX
			1,000-10,000	XXXO
Residue, Nonfilterable	Water	mg/L	1-10	X.
			10-100	XX
			100-1,000	XXX
			1,000-10,000	XXXO
Residue, Settable	Water	ml/L	1-10	X.X
			10-50	XX
Residue, Total	Water	mg/L	1-10	X.
			10-100	XX.
			100-1,000	XXX
			1,000-10,000	XXXO
	Solids	%	0.01-1.0	O.X
			1.0-10	X.X
			10-100	XX
Residue, Total Volatile	Water	mg/L	1-10	X.X
			10-100	XX.
			100-1,000	XXX
			1,000-10,000	XXXX
	Solids	%	0.01-1,0	O.X
			1.0-10	X.X
			10-100	XX
Sulfate	Water	mg/L	5-100	XX
			100-1,000	XXO
Sulfide	Water	mg/L	0.01-1.0	O.XX
			1.0-10	X.X
			10-100	XX
Total Organic Carbon	Water	mg/L	0.1-1.0	O.X
			1.0-10	X.X
			10-100	XX.
			100-1,000	XXO
Turbidity	Water	NTU	0.05-0.1	O.OX
			0.1-1.0	O.X
			1.0-10	X.X
			10-100	XX

Table 9-1. Significant Figures Used in Reporting Data

PARAMETER AND SW-846 METHOD	Sample Type	Units	Range	Significant Figures
Volatile Organics (8010)	Water	µg/L	0.1-10.0	X.X
			10-100	XX.X
			100-1,000	XXX
			1,000-10,000	XXXO
	Solids	%	0.01-0.10	O.OX
			0.10-1.0	O.XX
			1.0-10	X.XX
			10-100	XX.X
			100-1,000	XXX
Volatile Organics (8020)	Water	µg/L	0.1-10.0	X.X
			10-100	XX.X
			100-1,000	XXX
			1,000-10,000	XXXO
	Solids	%	0.01-0.10	XXXO
			0.10-1.0	O.OX
			1.0-10	X.XX
			10-100	XX.X
			100-1,000	XXX
Chlorinated Pesticides/PCB's (8080)	Water	µg/L	0.01-0.10	O.OX
			0.10-1.0	O.XX
			1.0-10	X.XX
			10-100	XX.X
			100-1,000	XXX
	Solids	%	0.01-0.10	O.OX
			0.10-1.0	O.XX
			1.0-10	X.XX
			10-100	XX.X
			100-1,000	XXX
Volatile Organics (8240)	Water	µg/L	1.0-10	X.XX
			10-100	XX.X
			100-1,000	XXX
			1,000-10,000	XXXO
	Solids	%	0.01-0.10	O.OX
			0.10-1.0	O.XX
			1.0-10	X.XX
			10-100	XX.X
			100-1,000	XXX

Table 9-1. Significant Figures Used in Reporting Data

PARAMETER	Sample Type	Units	Range	Significant Figures
Acidity	Water	mg/L	1-10.000	XXO
Alkalinity	Water	mg/L	1-1,000	XXX
			1,000-10,000	XXXO
Ammonia, N	Water	mg/L	0.05-1.0	O.XX
			1.0-10.0	X.XX
			10.0-100	XX.X
	Solids	mg/kg	1-100	XX
			100-1,000	XXO
Biological Oxygen Demand (BOD)	Water	mg/L	1-10	X.
			10-100	XX
			100-1,000	XXO
			1,000-10,000	XXOO
Bromide	Water	mg/L	1.0-10	X.X
CEC	Soil	meq/g	1-1,000	XXX
Chemical Oxygen Demand (COD)	Water	mg/L	10-100	XX
			100-1,000	XXO
Chloride	Water	mg/L	1-10	X.
			10-100	XX
			100-1,000	XXO
Color	Water	PT-Co Units	1-10	X.
			10-100	XO
			100-1,000	XOO
Coliform Bacteria	Water	#/100 mL	1-100	XX
			100-1,000	XXO
			1,000-10,000	XXOO
Conductivity	Water	umho	1-10	XX
			10-100	XXO
			100-1,000	XXOO
Cyanides	Water	mg/L	0.01-1.0	O.XX
			1-10.0	X.XX
			10-100	XX.X
Fluoride	Water	mg/L	0.01-1.0	O.XX
			1-10.0	X.XX
			10-100	XX.X
Flashpoint	All	Degrees in C	20-100	XX
			100-110	XXX
Gross Alpha or Beta	Water	pCu/L	5-100	XX

Table 9-1. Significant Figures Used in Reporting Data

PARAMETER	Sample Type	Units	Range	Significant Figures
Hardness, Total	Water	mg/L	1-100	XX
			1-1,000	XXX
			1,000-10,000	XXXO
MBAS	Water	mg/L	0.01-1.0	O.XX
			1.0-10	X.XX
			10-100	XX.X
Mercury	Water	µg/L	0.1-1.0	O.X
			1.0-10	X.X
			10-100	XX
			100-1,000	XXX
	Solids	%	0.01-0.10	O.OX
			0.1-1.0	O.XX
			1.0-10	X.X
			10-100	XX
Metals	Water	µg/L	0.1-1.0	O.X
			1.0-10	X.X
			10-100	XX
			100-1,000	XXX
			1,000-10,000	XXXO
	Solids	mg/L	1.0-10	X.X
			10-100	XX
			100-1,000	XXX
			1,000-10,000	XXXO
Nitrate or Nitrite Nitrogen	Water	mg/L	0.05-0.10	O.XX
			0.10-1.00	O.XX
			1.00-10.0	X.XX
			1.0-100	XX.X
Total Kjeldahl Nitrogen	Water	mg/L	0.1-1.0	O.XX
			1.0-10.0	X.X
			10-100	XX
			100-1,000	XXX
	Solids	%	10-100	XX
			100-1,000	XXX
			1,000-10,000	XXXO
Oil/Grease	Water	mg/L	0.5-10	X.X
			10-100	XX
			100-1,000	XXO
	Solids	%	10-100	XX
			100-1,000	XXO
			1,000-10,000	XXOO

Table 9-1. Significant Figures Used in Reporting Data

PARAMETER AND SW-846 METHOD	Sample Type	Units	Range	Significant Figures
Phosphorous	Water	mg/L	0.01-0.1	O.XX
			0.1-1.0	O.XX
			1-10	X.XX
			10-100	XX.X
Total Organic Halogens (TOX) (9020)	Water	µg/L	1-10	X.X
			10-100	XX.X
			100-1,000	XXX
			1,000-10,000	XXXO

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9.2 Laboratory Deliverables (Reporting)

Table 9-2 describes the information to be provided by the contracted laboratories in each data package submittal.

9.2.1 Level D

For Level D QC, a CLP data package shall be delivered for all the CLP parameters (volatiles, semi-volatiles, pesticides/PCBs, metals and cyanide). This shall include the summary package and the remainder of the package, which includes but is not limited to initial and continuing calibration, matrix spikes, matrix spike duplicates, method blanks (water blanks, extraction blanks, digestion blanks), duplicates, laboratory control samples, surrogate spike recoveries, chromatograms, mass spectra, and adsorbance data.,

For methods which are not defined by CLP, the calibration information, method blanks, reagent water (blank) spikes, laboratory control samples, matrix spikes, matrix spike duplicates, chromatograms, and adsorbances shall be reported. Control chart plots of associated blank spike data must also be presented with the data.

9.2.2 Level C

For Level C QC, the method blanks, blank spikes, surrogates, matrix spikes, matrix spike duplicates, duplicates, laboratory (sample) duplicates, and initial and continuing calibration data

Table 9-2. Data Set Deliverables for Level C QA

	Method Requirements	Deliverables
Organics	- Method blank spikes with results and control charts. Run with each batch of samples processed.	Control Chart
	- Results to be reported on CLP Form 1 or spreadsheet per Sect. 9. Sample results using CLP data flags.	Form 1 or Sect. 9 1/Sample chromatograms/and mass spectra
	- Surrogate recovery from samples reported on CLP Form 2. Surrogates to be used in volatiles, semivolatiles, pesticides/ PCB. For volatiles by GC, the names of surrogates should be changed to reflect the surrogate used.	Form 2
	- Matrix spike/spike duplicate 1 spike and spike duplicate per 20 samples of similar matrix reported on Form 3.	Form 3
	- Method blank reported on CLP Form 4.	Form 4 or Sect. 9
	For volatiles by GC, a similar format will be used as CLP Form 4 for blanks.	
	- GC/MS tuning for volatiles/semi-volatiles. Report results on Form 5.	Form 5
	- Initial calibration data reported on Form 6.	Form 6
	For volatiles by GC, the initial calibration data with response factors must be reported.	No Form
	For pesticide/PCB data Form 9 must be used for calibration data.	Form 9
	- Continuing calibration GC/MS data reported on Form 7.	Form 7
	For volatiles, GC data, the response factors and their percent differences from the initial must be reported.	No Form

Table 9-2. (continued)

	Method Requirements	Deliverables
Organics (cont)	- Internal Standard Area for Volatiles and Semivolatiles.	Form 8
	- For pesticides/PCB data, the CLP Form 9 must be presented.	Form 9
	No chromatograms or mass spectra are presented for calibration. These data should be filed in the laboratory and available if problems arising in reviewing/ validating the data. The calibration information should be available for checking during on-site audits.	
	- Internal standard area for GC/MS analyses CLP Form VIII shall be supplied.	
	- Second column confirmation shall be done for all GC work when compounds are detected above reporting limits. Chromatograms of confirmation must be provided.	Chromatograms
Metals	- Level C, requirements	Deliverables
	- Sample results with CLP flagging system	CLP Form 1 or Sect. 9
	- Initial and continuing calibration	CLP Form 2, Part 1 only
	- Blanks 10% frequency	Form 3
	- Method blank taken through digestion (1/20 samples of same matrix)	Form 3 or Sect. 9
	- ICP interference check sample	Form 4
	- Matrix spike recovery (1 per 20 samples of similar matrix)	Form 5, Part 1
	- Postdigestion spike sample recovery for ICP metals. Only done if predigest spike recovery exceed CLP limits.	Form 5, Part 2 (never used for GFAA work)

Table 9-2. (continued)

	Method Requirements	Deliverables
Metals (cont)	- Postdigest spike for GFAA	Recovery will be noted on raw data
	- Duplicates (1 per 20 samples will be split and digested as separate)	Form 6 samples
	- Method blank spike information will be plotted on control chart, one per batch of samples processed.	Control chart
	- Standard addition. The decision process outlined in CLO page E-3 will be used to determine when standard additions are required.	Form 8
	Holding times.	Form 10
Wet Chemistry	Level C	
	- Blank spike 1/batch	Control chart
	- Method blank 1/batch	Report result No format
	- Sample results	Report result No format
	- Matrix spike/spike duplicate or calibration information	Report result if applicable
	- Calibration check report percent RSD or percent difference from initial calibration	Report percent or percent difference No format

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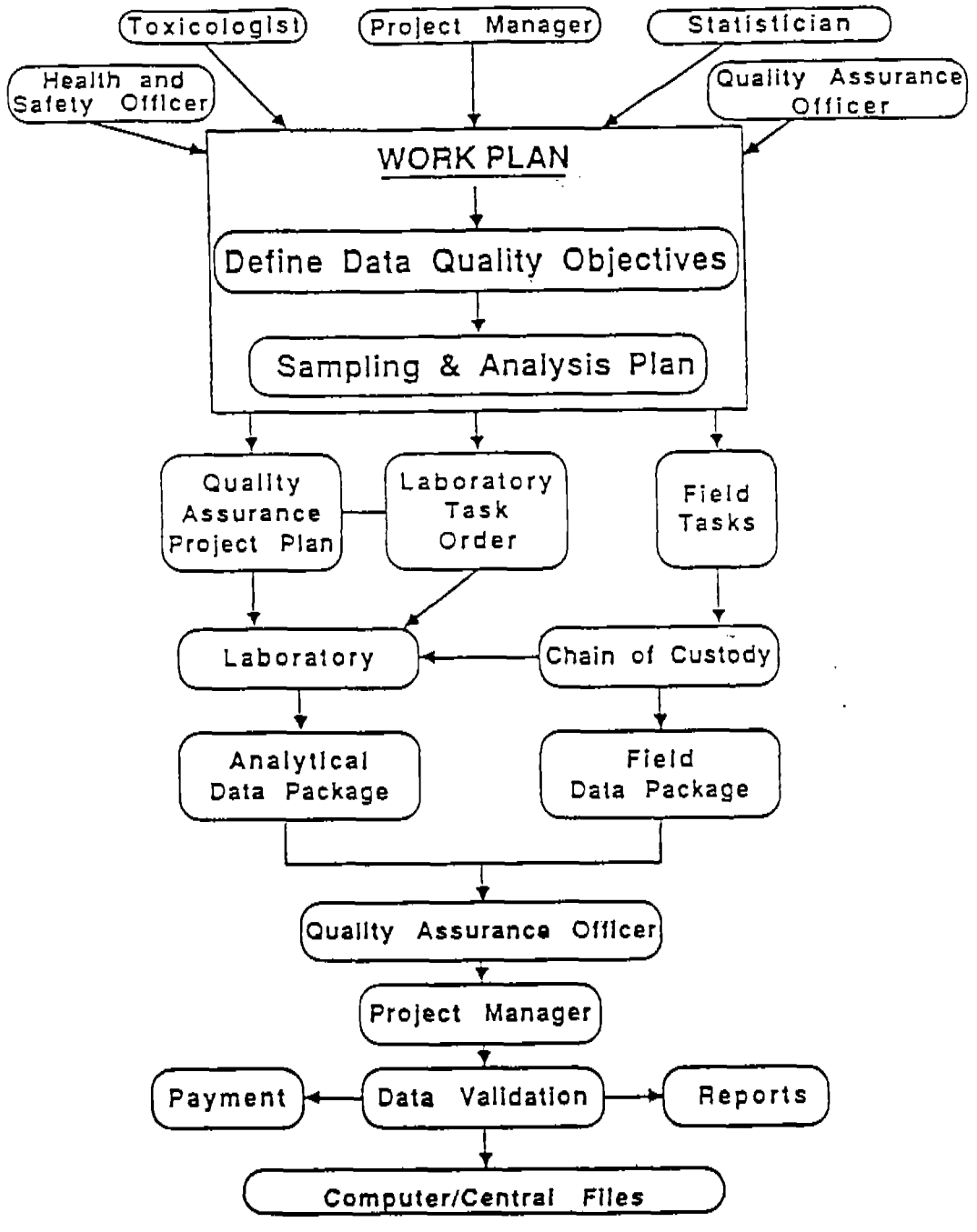
shall be reported. These deliverables and their required format are summarized and explained in more detail in Table 9-2.

9.3 Data Validation

The contract laboratories will utilize precision and accuracy criteria presented in their respective generic QAPs as guidance for internal laboratory data validation prior to submittal of data packages. The data validation procedures employed by ABB-ES will include an evaluation of the field data package and an evaluation of the laboratory analytical data package. The data validation procedures that will be used to evaluate data for this project are presented in detail in the Data Analysis Plan (Appendix 4.2 of Volume 4.0, the Basic Site Work Plan).

9.4 Data Management

All data will be managed as described in the Data Management Plan (Section 2.0 of Volume 1, Organization and Planning). A data management flow chart is presented in Figure 9-1 to illustrate the flow of data through the project management system.



DATA MANAGEMENT FLOW CHART

FIGURE 9-1

REMEDIAL INVESTIGATION/ FEASIBILITY STUDY QUALITY ASSURANCE PROGRAM PLAN

NAS JACKSONVILLE SEPTEMBER 1991

10.0 PERFORMANCE AND SYSTEM AUDITS

Performance and system audits for sampling and analysis operations consist of on-site review of field and laboratory quality assurance systems and on-site review of equipment for sampling, calibration, and measurement.

10.1 Field System Audit

The Field Coordinator, the Project Manager, and/or the QA Officer will make a non-scheduled visit to the sampling location to evaluate the performance of field personnel and general field operations in progress. The auditor will observe the performance of the field operations team during each kind of activity, such as water-level readings and sampling rounds. A systems audit of field operations personnel by the project QA officer will be performed on a bi-annual basis and a field audit report of the sampling team will be maintained on file by the Contractor.

10.2 Laboratory System Audit

A laboratory systems audit is routinely conducted, at least biannually, of all laboratories subcontracted by ABB Environmental Services, Inc. These audits assure that systems and operational capability is maintained and test methodology and quality control measures for the project are being followed as specified in the laboratory written standard operating procedures and generic Quality Assurance Plans. The Systems Audit Checklist used by the EPA Contract Laboratory Program (CLP) forms the procedural basis for conducting these audits.

The contracted laboratories for this investigation participate in the EPA Contract Laboratory Program or other federal and state agency programs that require recurring on-site audits. In addition, laboratory initiated audits may also be conducted by each laboratory's QA Officer on a routine basis.

10.3 Performance Evaluation Audits

A performance evaluation (PE) audit evaluates a laboratory's ability to obtain an accurate and precise answer in the analysis of a known check sample by a specific analytical method. Following the analytical data validation described in Section 9.0, a performance evaluation audit of the laboratory may be conducted by ABB-ES. This audit may be conducted if it is determined that the quality assurance data provided in the analytical data package or other parameters as described in Sections 8.0 and 9.0 are outside acceptance criteria control limits. These PE audits may include a review of all raw data developed by the laboratory and not reported (laboratory non-reportables) and the submission of blind spiked check samples for the analysis of the parameters in question. These check samples may be submitted disguised as field samples, in which case, the laboratory will not know the purpose of the samples or the samples may be obvious (known) check samples (EPA or NIST traceable).

PE Audits also may be conducted by reviewing the laboratory's results from "round-robin" certification testing and/or EPA CLP evaluation samples. An additional component of PE Audits includes the review and evaluation of raw data generated from the analysis of PE samples and actual field samples that may be in question.

Results of PE Audit and progress reports concerning laboratory performance will be available for Navy review.

10.4 Regulatory Audits

It is understood that field personnel and subcontractor laboratories also are subject to quality assurance audits by the Navy, FDER, and EPA.

11.0 PREVENTATIVE MAINTENANCE

11.1 Field Equipment

A listing of the field testing equipment that may require preventive maintenance and routine service are presented in Table 11-1, Preventive Maintenance Procedures are described in Attachment J. Analytical field laboratory equipment must be routinely serviced after each field program, and checked for proper operation prior to analyzing air samples at the PSC. Records of calibration and maintenance activities for each piece of equipment are maintained in log books assigned to that instrument.

11.2 Laboratory Equipment

To obtain good analytical data, all instruments must be operating properly at all times. To ensure that instruments are operating properly, rigorous maintenance and trouble-shooting procedures must be followed.

All laboratory instruments, including the inductively coupled plasma spectrometers, graphite furnace atomic absorption spectrophotometers, gas chromatographs, and mass spectrometers, undergo regular maintenance as prescribed in the manufacturer's operation manual for each of the instruments. Trouble shooting procedures also are carried out for each instrument according to instructions in the operation manual.

All instruments will be calibrated each day that analyses are conducted. A record is maintained of all instrument calibrations.

Table 11-1
LIST OF FIELD TESTING EQUIPMENT

Field Instrumentation

pH meters (LaMotte Chemical Products Model HA-pH meter and Myron L. Company Model EP II/pH)
Conductivity meters (PI DspH-1 pH conductivity meter and Trimar Industries Model 333 Tripar Meter)
S-C-T Meter (YSI Model No. 33)
OVA (Century Model OVA 128)
Data logger (ORS Interface Probe and ORS Model EL-200 Groundwater Monitoring System)
Photoionization Analyzer (Photovac TIP and HNU Model 101)
Portable Gas Chromatographs (HNU Model 311 and Photovac 10S50)
Dräeger Mult-Gas Detector
Hydrogen Sulfide Meter (Industrial Scientific MX 241)
Oxygen Indicator (MSA Model E)
Methane Meter (MSA Model 60 Gascope)
Explosimeter (Industrial Scientific MX 241)
Field grade thermometers
Water level indicators
Velocity meter (Surface water)
Water level recorder (Stevens)

12.0 ASSESSMENT OF DATA PRECISION, ACCURACY, AND COMPLETENESS

12.1 Precision

Precision is an estimate of the reproducibility of a method, and it may be estimated by several statistical tests including the coefficient of variation and the relative percent difference between replicate (duplicate) samples. ABB-ES will determine the precision of the analyses conducted during this investigation by reviewing the results of field replicate samples and laboratory duplicate samples (where applicable), then, if sufficient data are obtained, the arithmetic mean and standard deviation of a group of results may be calculated.

Precision can then be assessed by using the coefficient of variation (CV), which expresses the standard deviation as a percentage of the mean. Specific statistical comparison of duplicate samples (field and laboratory), as a measure of precision evaluating both sample collection procedures and laboratory instrument performance, may be accomplished by first comparing the obtained duplicate results with the published EPA criteria for method precision. If EPA criteria is not available, the relative percent difference (RPD) may be calculated and compared to the precision criteria established by the laboratory for the analysis of laboratory duplicates.

12.2 Accuracy

The accuracy of a method is an estimate of the difference between the true value and the determined mean value. Certain QA parameters such as laboratory control samples, reagent water spike

samples, QC check samples, matrix spike samples, and surrogate spike samples all have known concentrations prior to analysis. By comparing the percent recovery of the analysis of these samples to the known true value it is possible to measure the accuracy of the analysis. In routine practice the laboratory collects recovery data for each of these parameters from approximately 30 analytical batches. The percent recovery data are averaged and the standard deviation of the percent recoveries is calculated. Then, based on the desired level of confidence, ranges will be established as practical control limits. To be valid, these control limits must be at least as stringent as the accuracy limits specified by EPA for each analyte measured by the method. If the determined control limits are within the range established for the analyte and method by EPA then the determined range becomes the practical control limits used by the laboratory until another set of data is developed and new control limits are calculated. Specific procedures addressing the development of these control values and preparation of control charts are presented in Section 4.0 of NEESA 20.2-047B referenced in Section 1.0.

Specific statistical comparison of percent recovery values and control limits (DQOs) reported by the laboratory as a measure of method accuracy will be compared with the published EPA criteria for the accuracy of an individual method. Data not meeting the EPA criteria for accuracy may be considered qualitative or unusable.

12.3 Completeness

Completeness is a measure of the amount of data obtained from a measurement process compared to the amount of data that was expected to be obtained. Data completeness will be expressed both as the percentage of total tests conducted that are deemed valid and as the percentage of the total tests required in the scope of work that are deemed valid.

12.4 Minimum Statistical Control Charting

At a minimum, the laboratory shall run two control charts for each analyte listed in Table 12-1. This table describes the number of analyses required at a minimum to be monitored through the measurement control program.

Table 12-1

MINIMUM CONTROL ANALYSES

Number	Analyses
10	Metals by AA and ICP
1	Mercury
3	Volatiles
1	Wet Chemicals
1	PCB
2	Pesticides
3	Base, neutral extractables
3	Acids extractables

The control charts shall monitor the laboratory measurements obtained from individually spiked water samples and individually spiked soil samples.

Each control chart shall consist of a center line, two warning limits, and two control limits (Figure 12-1). The control chart parameters should be calculated according to the formula provided in Table 12-2. A minimum of 20 points/chart shall be obtained prior to the initial attempt to establish the control chart parameters. If the laboratory does not have 20 points to use in setting control chart limits, the recommended EPA recoveries for the method will be used until such time as 20 points are attained.

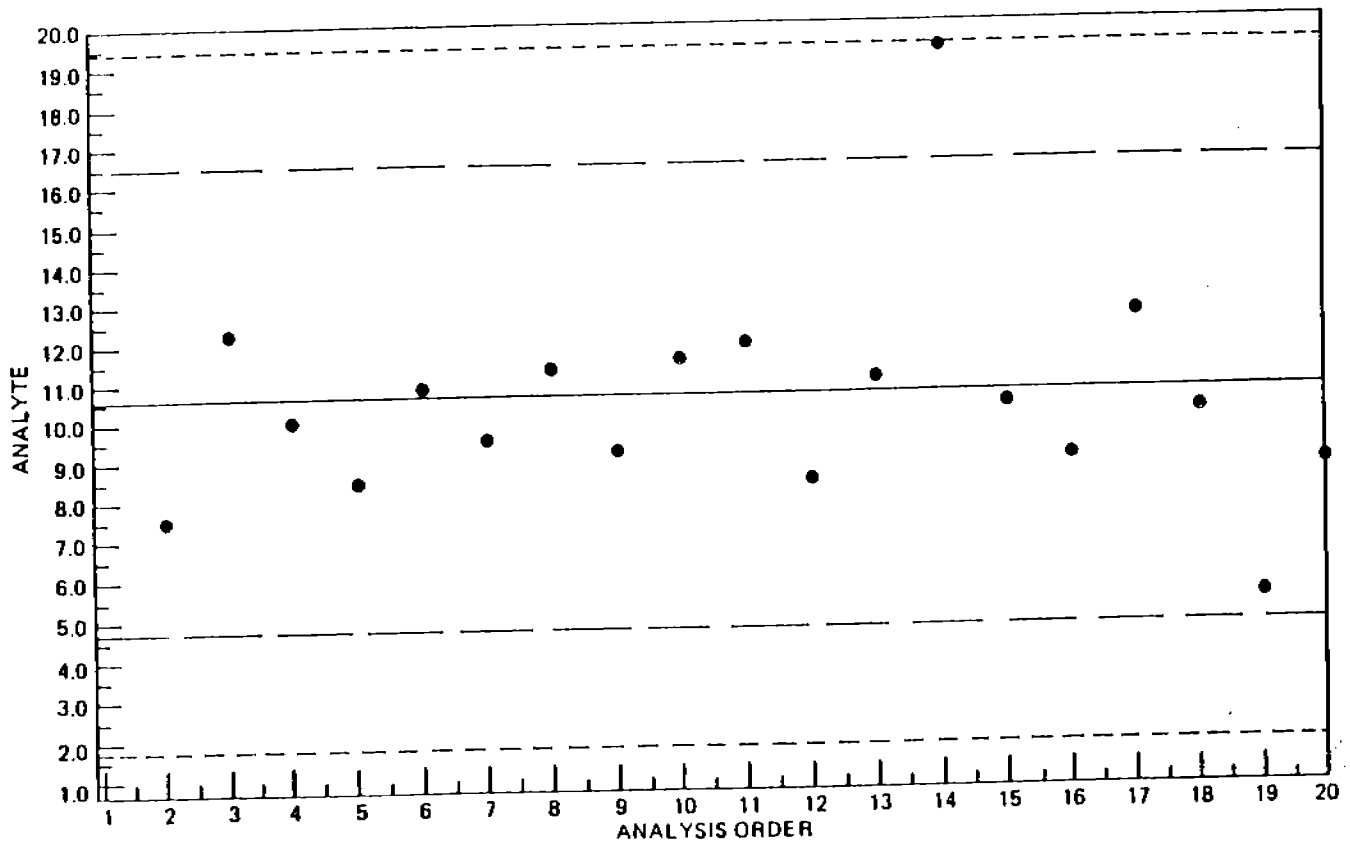
12.5 Minimum Criteria for an Out-of-Control Condition

A laboratory process for a particular analyte should be considered out of statistical control whenever, as a minimum, any one of the following conditions is demonstrated by a control chart monitoring that analyte.

1. Any one point is outside of the control limits.

2. Any three consecutive points are outside of the warning limits.

3. Any eight consecutive points are on the same side of the centerline.



Control Chart Example Data and Control Values of Table

CONTROL CHART

12-1

REMEDIAL INVESTIGATION/
FEASIBILITY STUDY
QUALITY ASSURANCE
PROGRAM PLAN

NAS JACKSONVILLE
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Table 12-2. Control Chart Formulae for Water and Soil Control Batch Program

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Definitions

Let X_1, X_2, X_3, ..., X_n (n>=20) represent the first n time-ordered determinations for an analyte of Table 10 from either the water or soil control batch program.

The, define the following:

$\bar{X}$ = average = $(1/n)(X_1 + X_2 + \ldots + X_n)$,
$Ri = |X_i - X_{(i-1)}|$ $i = 2,3,\ldots,n$
R_2 = average moving range of two successive points,

$$= [1/(n-1)]\,[|X_2 - X_1| + |X_3 - X_2| + \ldots + |X_n - X_{(n-1)}|].$$

Control Chart Parameter Estimation

Parameter	Symbol	Formula
Centerline	CL	$\bar{X}$
Upper control limit	UCL	$\bar{X} + 3R_2/d_2$
Lower control limit	LCL	$\bar{X} - 3R_2/d_2$
Upper warning limit	UWL	$\bar{X} + 2R_2/d_2$
Lower warning limit	LWL	$\bar{X} - 2R_2/d_2$

(d_2 = 1.128, factor from tables for control charting within n = 2, see American Society for Quality Control).

4. Any six consecutive points are such that each point is larger (smaller) than its immediate predecessor.

5. Any obvious cyclic pattern is seen in the points.

The generic QAPs for each contracted laboratory describe the corrective action steps which will be taken in the occurrence of an out-of-statistical-control condition from the control charts. The steps taken include those actions related to the quality and stability of the control batches, sampling, spiking, and handling of the control samples.

12.6 Statistical Quality of the Control Charts

The formulae for the control chart parameters given in Table 12-2 are those commonly accepted and used. They are based on normally distributed measurements and short-term variation. If these bases are inappropriate, the charts will not perform as desired. The charts will either falsely signal out-of-control warnings more frequently than usual, fail to detect existing out-of-control conditions as often as they ordinarily would, or both (for different types of out-of-control states). In order to correct any problems due to improperly fitting control charts, the laboratory may propose alternate methods for setting the control chart parameters. All such proposals should include data and supportive statistical evidence. Possible alternate statistical approaches can include using nonparametric techniques, medians instead of averages for the centerlines, identifying sources of variation, using long-term variation instead of short-term variation in setting limits, and transformations of the data.

Example of Setting Control Limits

As an example of setting control chart parameters and a very brief introduction to interpretation of the chart, consider the following:

A sample is obtained from the batch of control soil which has been thoroughly mixed and is stored in a special atmospherically controlled location. It is carefully spiked with known amounts of the constituents of interest and sent to sample preparation to be processed and analyzed with other samples. It is subjected to the same types of treatment as the other samples in the batch. This scenario is repeated until 20 control samples have been analyzed.

The data are listed in Table 12-3. Also shown are calculations according to the formulae in Table 12-3. Figure 12-1 displays the results of the initial attempt at sizing the data to the control chart parameters. The point falling above the upper control limit was investigated. It was determined that the sample had received a double spiking and, thus, was deleted from the second iteration calculation of the chart parameters. Figure 12-2 shows the second fitting. This fit appears adequate. Had no explanation for the high result been found, the first calculations would have been used. The

Table 12-3. Data and Calculations for Control Chart Example

Order	Result	Moving Range $\lvert XI - XI - 2 \rvert$
1	12.25	
2	7.52	4.73
3	12.29	4.78
4	10.04	2.25
5	8.48	1.56
6	10.89	2.40
7	9.57	1.32
8	11.40	1.83
9	9.28	2.12
10	11.66	2.39
11	12.06	0.40
12	8.52	3.54
13	11.14	2.62
14	19.56	8.42
15	10.48	9.08
16	9.12	1.35
17	12.79	3.66
18	10.30	2.49
19	5.54	4.76
20	8.93	3.39
Sum	211.82	63.0

First Calculations (Fig. 4.1)

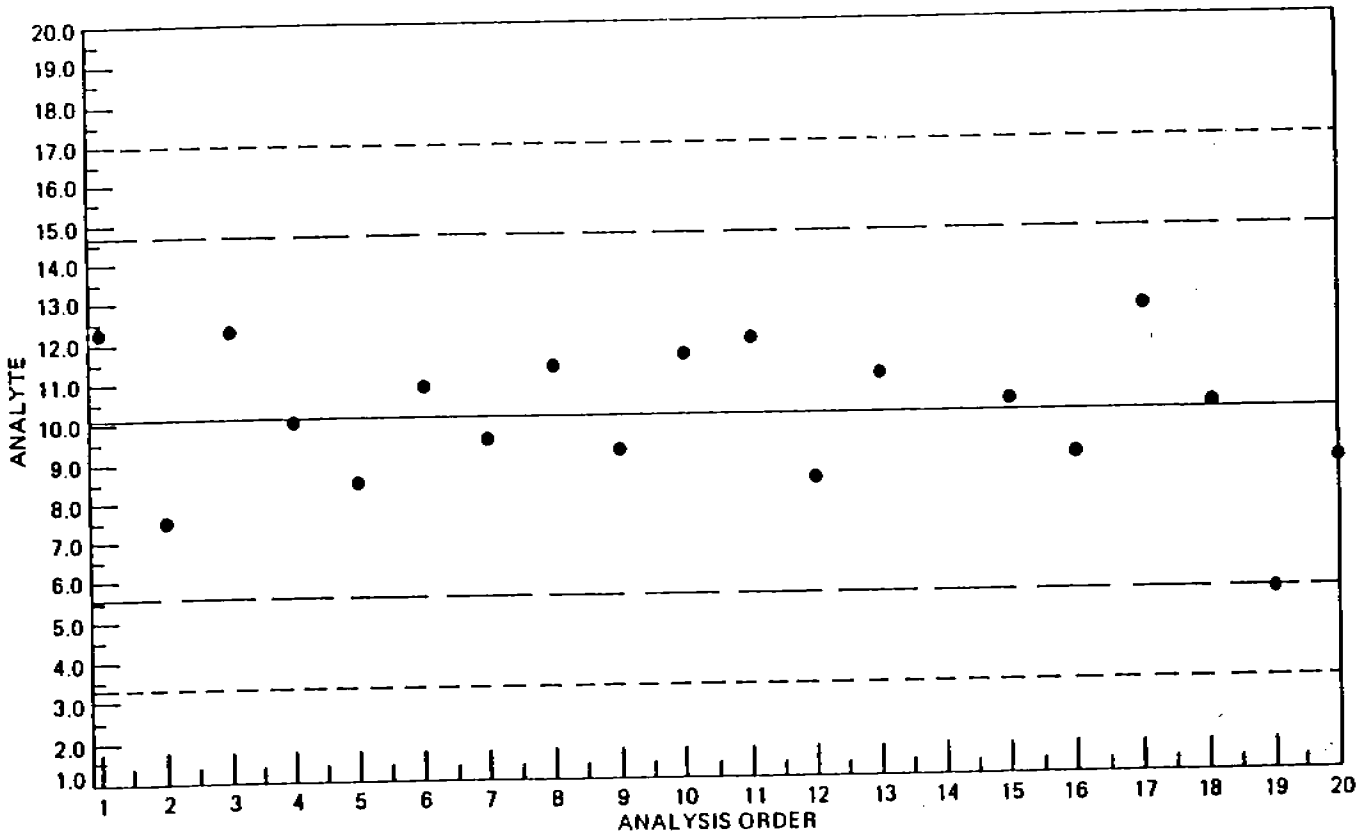
Average = 211.82/20 = 10.591
Average Moving Range = 63.09/19 = 3.321 R_2

Centerline = 10.591
Upper control limit = 10.591 + 3 x 3.321/1.128 = 19.423
Lower control limit = 10.591 - 3 x 3.321/1.128 = 1.758
Upper warning limit = 10.591 + 2 x 3.321/1.128 = 16.479
Lower warning limit = 10.591 - 2 x 3.321/1.128 = 4.703

Second Iteration After Removing Point #14 (Fig. 4.2)

Average = 192.26/19 = 10.119
Average moving range = 46.26/18 = 2.570

Centerline = 10.119
Upper control limit = 10.119 + 3 x 2.570/1.128 = 16.954
Lower control limit = 10.119 - 3 x 2.570/1.128 = 3.284
Upper warning limit = 10.119 + 2 x 2.570/1.128 = 14.676
Lower warning limit = 10.119 - 2 x 2.570/1.128 = 5.562



Control Chart Example Data and Second Iteration Control Values of Table

CONTROL CHART FOR PROBLEM EXAMPLE

FIGURE 12-2

REMEDIAL INVESTIGATION/
FEASIBILITY STUDY
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chart would have been placed under a probationary condition and its performance monitored.

13.0 CORRECTIVE ACTION

13.1 Field Conditions

During the course of implementation of the Basic Site Work Plan, the field personnel are responsible for seeing that field instruments are functioning properly, that work progresses satisfactorily, and that work performed is in compliance with the QAPP.

If a problem is detected by the field personnel, the U.S. Navy Project Manager and the Contractor Project Manager shall be notified immediately by the Field Coordinator, at which time the problem will be further investigated and corrective action will begin. Similarly, if a problem is identified during a routine audit by the project QA officer or the EPA/FDER Project Manager or QA Officer, an immediate investigation will be undertaken and the corrective measures deemed necessary will be implemented as quickly as possible.

13.2 Laboratory Corrective Action

Within time constraints imposed by individual analysis procedures, data evaluations necessary to verify proper analytical function must be performed as early as possible in the analysis program.

When practical, a preliminary check of standard curve linearity, precision, and sensitivity should be performed either before the analysis of the samples is begun (manual procedures), or while the first samples are being analyzed (automated procedures).

Results are compared to quality assurance control limits established by the laboratory and EPA.

Any analysis not conforming to control limits for precision, accuracy, detection limit, or linearity will be halted until the problem is identified and corrected. Laboratory batch sheets and control charts will document data evaluations and will contain all information necessary for assessment of the data quality, including: (1) information regarding indices of sensitivity, (2) precision, (3) detection limit, and (4) accuracy achieved during that run or batch.

For out-of-control incidents, it is essential to document the nature of the incident and the corrective actions taken to set the system back in control. A corrective action report, to be signed by the laboratory director and the laboratory quality assurance officer, should be prepared and reported in the narrative summary of the laboratory report. The following topics should be discussed:

1) Where did the out-of-control incident occur (laboratory name, address, telephone number, section name)?

2) When did the incident occur and when was it corrected?

3) Who discovered the out-of-control incident, verified the incident, and corrected the problem?

4) What was the name of the test?

5) What was the disposition of the test or control and/or instrument?

6) What was the nature of the corrective action?

7) What will be done to prevent the reoccurrence of the problem?

8) Why did the incident happen (if scientific explanation is available)?

A copy of the subject control charts and other data describing the out-of-control conditions should be included in the corrective action report. All out-of-control incident documentation and copies of the corrective action reports should be (1) placed in the laboratory archive record for the sample(s) in question and, (2) placed in the laboratory QA officers file of incidents documentation.

13.3 Reporting of Corrective Actions

In all cases in which corrective actions of field procedures are required a written report describing the nature of the problem, an evaluation of the cause, if known, and the action taken will be prepared by the Contractor Field Coordinator or the Project QA Officer and submitted to the Contractor Project Manager, the Project QA Officer (if not preparing the report), and the Project Officer.

Any corrective actions taken by the contracted laboratories will be reported to the QA Officer. The laboratory will include in

each data package a discussion of the problems encountered and corrective actions taken. In addition, the laboratories will maintain a file for Contractor review that documents all corrective actions taken regardless of whether the actions performed were pertinent to the analysis of samples from Geraghty & Miller projects.

Reports of corrective actions taken during the implementation of the Basic Site Work Plan will be provided to the U.S. Navy according to the frequency and procedures specified in the Data Analysis Plan (Appendix 4.2 of Volume 4, the Basic Site Work Plan).

14.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

Each day that field activities are conducted on-site, a representative of the Field Team will complete a Quality Control Report (QCR) (Figure 14-1). These reports will be transmitted weekly to the Project QA Officer for review and inclusion into the project file. These DQCRs, along with associated field records and laboratory data, form the basis for preparing a Quality Control Summary Report (QCSR).

A Final QCSR for the RI/FS program will be prepared for each OU following completion of data gathering activities. Each report will address the following:

1) Quality assurance activities and quality of collected data (results of data validation);

2) Equipment calibration and preventive maintenance activities;

3) Laboratory quality control data pertinent to the site;

4) Evaluation of data completeness and usability; and

5) Field and/or laboratory QA problems and implemented corrective actions.

All quality assurance documentation and reports will be available for review by EPA Region IV and the FDER.

QUALITY CONTROL REPORT
NAS JACKSONVILLE

Date: _____

A. Weather (temperature, wind speed and direction, precipitation, etc.): _____

B. Work Performed: _____

C. Sampling Performed (location/number, sample type, etc.):

D. Field Analyses Performed (including instrument checks, calibration, etc.): _____

E. Problems Encountered and Corrective Actions Taken (sampling problems, alternate methods/locations, etc.): _____

F. Quality-Control Activities Initiated: _____

Signature of Reporter: _____

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A-E DATA QUALITY CONTROL REPORT

FIGURE 14-1

An Interim Quality Assurance report as indicated in the Data Analysis Plan will be prepared and submitted to the U.S. Navy. These reports will cover routine quality assurance activities such as:

1) Results of QA audits;
2) Results of PE samples;
3) Revision of laboratory data quality objectives;
4) Summary of data gathering tasks; and
5) Summary of QA problems and corrective actions.

15.0 RESUMES

Resumes of key ABB-ES personnel are included in Attachment K of this QAPP.

Table 1-1

GENERAL GUIDE TO METHODS

AND

STANDARDIZED PARAMETER LISTS

Table 1-1

GENERAL GUIDE TO METHODS

AND

STANDARDIZED PARAMETER LISTS

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SECTION 1.0

INTRODUCTION AND DIRECTIONS FOR USE

Introduction and Directions for Use

The General Guide to Methods contains a tabulation of analytical parameters for both Water and Soil/Solid Matrices that is to be used as a guide to selecting proper methods of analysis. This tabulation also includes a listing of method detection limits, holding times, container types, and preservative requirements. It should be understood that the detection limits described for each method are the detection limits published by the EPA in each method. These detection limits are "supposed" to be achievable under ideal circumstances. However, many factors are involved in the determination of detection limits and these numbers may not be achievable for your samples. The detection limits listed are provided to serve you as a guide in helping you select the method that appears most capable of meeting your requirements. You should always discuss your detection limit requirements with the laboratory to ensure you have selected the appropriate methods of analysis.

The Standardized Analyte Lists have been prepared for those methods in which more than one chemical analyte (compound/element) is reported. A copy of these lists has been provided to each laboratory to standardize the compounds reported for each method. When ordering your tests you also should include a copy of the appropriate list with your laboratory task order. Instructions for using each list are provided at the bottom of the list.

SECTION 2.0

GUIDE TO METHODS

WATER MATRIX

WATER MATRIX

		Method Prep/Analysis	Ref	Method Detection Limit	Holding Time	Container [1/]	Perservative
PHYSICAL PROPERTIES							
Specific Conductance		120.1	1	0.1 umhos/cm	28 days	100 mL P,G	cool, 4 °C
		9050	3	0.1 umhos/cm	28 days	100 ml P,G	cool, 4 °C
Hardness, Total							
	colorimetric	130.1	1	0.1 mg/L,$CaCO_3$	6 months	100 mL P,G	HNO_3 to pH<2
	titrimetric	130.2	1	0.1 mg/L,$CaCO_3$	6 months	100 mL P,G	HNO_3 to pH<2
pH	electrometric	150.1	1	0.1 units	analyze immed.	25 mL P,G	none required
	electrometric	9040	3	0.1 units	analyze immed.	25 mL P,G	none
	paper	9041	3	0.1 units	analyze immed.	25 mL P,G	none
Residue (Solids)							
	filterable (TSS)	160.1	1	0.1 mg/L	7 days	100 mL P,G	cool, 4 °C
	non-filterable	160.2	1	0.1 mg/L	7 days	100 mL P,G	cool, 4 °C
	total	160.3	1	0.1 mg/L	7 days	100 mL P,G	cool, 4 °C
	volatile	160.4	1	0. mg/L	7 days	100 mL P,G	cool, 4 °C
	settleable matter	160.5	1	0.1 mL/L/hr	48 hours	1000 mL P,G	cool, 4 °C
Temperature	thermometric	170.1	1	0.1 °C	analyze immed.	1000 mL P,G	none required
Turbidity	nephelometric	180.1	1	0.01 NTU [2/]	48 hours	100 mL P,G	cool, 4 °C
Odor	threshold odor	140.1	1				

1/ Polyethylene (P) or glass (G) with required minimum collection volume. All glass containers must have Teflon-lined caps.

2/ NTU = Nephelometric turbidity units

WATER MATRIX

		Method Prep/Analysis	Ref	Method Detection Limit	Holding Time	Container 1/	Perservative
METALS ANALYSIS							
Aluminum							
	flame	202.1	1	0.1 mg/L	6 months	500 mL P,G	HNO_3 to pH<2
	furnace	202.2	1	3 ug/L	6 months	500 mL P,G	HNO_3 to pH<2
	ICP	200.7	1	45 ug/L	6 months	500 mL P,G	HNO_3 to pH<2
	flame	3010/7020	3	0.1 mg/L	6 months	500 mL P,G	HNO_3 to pH<2
	ICP	3010/6010	3	45 ug/L	6 months	500 mL P,G	HNO_3 to pH<2
Antimony							
	flame	204.1	1	0.2 mg/L	6 months	500 mL P,G	HNO_3 to pH<2
	furnace	204.2	1	3 ug/L	6 months	500 mL P,G	HNO_3 to pH<2
	ICP	200.7	1	32 ug/L	6 months	500 mL P,G	HNO_3 to pH<2
	flame	3010/7040	3	0.2 mg/L	6 months	500 mL P,G	HNO_3 to pH<2
	furnace	3005/7041	3	3 ug/L	6 months	500 mL P,G	HNO_3 to pH<2
	ICP	3010/6010	3	32 ug/L	6 months	500 mL P,G	HNO_3 to pH<2
Arsenic							
	ICP	200.7	1	53 ug/L	6 months	500 mL P,G	HNO_3 to pH<2
	furnace	206.2	1	1 ug/L	6 months	500 mL P,G	HNO_3 to pH<2
	AA, Hydride	206.3	1	2 ug/L	6 months	500 mL P,G	HNO_3 to pH<2
	ICP	3010/6010	3	53 ug/L	6 months	500 mL P,G	HNO_3 to pH<2
	furnace	3050/7060	3	1 ug/L	6 months	500 mL P,G	HNO_3 to pH<2
	AA, Hydride	3050/7061	3	0.002 mg/L	6 months	500 mL P,G	HNO_3 to pH<2
Barium							
	flame	208.1	1	0.1 mg/L	6 months	500 mL P,G	HNO_3 to pH<2
	furnace	208.2	1	2 ug/L	6 months	500 mL P,G	HNO_3 to pH<2
	ICP	200.7	1	2 ug/L	6 months	500 mL P,G	HNO_3 to pH<2
	flame	3010/7080	3	0.1 mg/L	6 months	500 mL P,G	HNO_3 to pH<2
	furnace	3020/7081	3	2 ug/L	6 months	500 mL P,G	HNO_3 to pH<2
	ICP	3010/6010	3	2 ug/L	6 months	500 mL P,G	HNO_3 to pH<2
Beryllium							
	flame	210.1	1	0.005 mg/L	6 months	500 mL P,G	HNO_3 to pH<2
	furnace	210.2	1	0.2 ug/L	6 months	500 mL P,G	HNO_3 to pH<2
	ICP	200.7	1	0.3 ug/L	6 months	500 mL P,G	HNO_3 to pH<2
	flame	3010/7090	3	0.005 mg/L	6 months	500 mL P,G	HNO_3 to pH<2
	furnace	3020/7091	3	0.2 ug/L	6 months	500 mL P,G	HNO_3 to pH<2
	ICP	3010/6010	3	0.3 ug/L	6 months	500 mL P,G	HNO_3 to pH<2
Boron							
	colorimetric	212.3	1	0.1 - 1 mg/L	6 months	500 mL P,G	HNO_3 to pH<2
	ICP	3010/6010	3	5 ug/L	6 months	500 mL p,G	HNO_3 to pH<2
Cadmium							
	flame	213.1	1	0.005 mg/L	6 months	500 mL P,G	HNO_3 to pH<2
	furnace	213.2	1	0.1 ug/L	6 months	500 mL P,G	HNO_3 to pH<2
	ICP	200.7	1	4 ug/L	6 months	500 mL P,G	HNO_3 to pH<2
	flame	3010/7130	3	0.005 mg/L	6 months	500 mL P,G	HNO_3 to pH<2
	furnace	3020/7131	3	0.1 ug/L	6 months	500 mL P,G	HNO_3 to pH<2
	ICP	3010/6010	3	4 ug/L	6 months	500 mL P,G	HNO_3 to pH<2

1/ Polyethylene (P) or glass (G) with required minimum collection volume. All glass containers must have Teflon-lined caps.

WATER MATRIX

	Method Prep/Analysis	Ref	Method Detection Limit	Holding Time	Container 1/	Perservative
METALS ANALYSIS						
Calcium						
ICP	200.7	1	7 ug/L	6 months	500 mL P,G	HNO, to pH<2
flame	215.1	1	0.01 mg/L	6 months	500 mL P,G	HNO, to pH<2
titrimetric	215.2	1	0.5 mg/L	6 months	500 mL P,G	HNO, to pH<2
flame	3010/7140	3	0.01 mg/L	6 months	500 mL P,G	HNO, to pH<2
ICP	3010/6010	3	10 ug/L	6 months	500 mL P,G	HNO, to pH<2
Chromium						
flame	218.1	1	0.05 mg/L	6 months	500 mL P,G	HNO, to pH<2
furnace	218.2	1	1 ug/L	6 months	500 mL P,G	HNO, to pH<2
ICP	200.7	1	7 ug/L	6 months	500 mL P,G	HNO, to pH<2
flame	3010/7190	3	0.05 mg/L	6 months	500 mL P,G	HNO, to pH<2
furnace	3020/7191	3	1 ug/L	6 months	500 mL P,G	HNO, to pH<2
ICP	3010/6010	3	7 ug/L	6 months	500 mL P,G	HNO, to pH<2
Hexavalent Chromium						
Coprecipitation	7195	3	5 ug/L	24 hours	500 mL P,G	cool, 4 °C
colorimetric	7196	3	500 - 5000 ug/L	24 hours	500 mL P,G	cool, 4 °C
flame	7197	3	1 ug/L	24 hours	500 mL P,G	cool, 4 °C
DPP	7198	3	10 ug/L	24 hours	P,G	cool, 4 °C
Cobalt						
flame	219.1	1	0.05 mg/L	6 months	500 mL P,G	HNO, to pH<2
furnace	219.2	1	1 ug/L	6 months	500 mL P,G	HNO, to pH<2
ICP	200.7	1	7 ug/L	6 months	500 mL P,G	HNO, to pH<2
flame	3010/7200	3	0.05 mg/L	6 months	500 mL P,G	HNO, to pH<2
furnace	3020/7201	3	1 ug/L	6 months	500 mL P,G	HNO, to pH<2
ICP	3010/6010	3	7 ug/L	6 months	500 mL P,G	HNO, to pH<2
Copper						
flame	220.1	1	0.02 mg/L	6 months	500 mL P,G	HNO, to pH<2
furnace	220.2	1	1 ug/L	6 months	500 mL P,G	HNO, to pH<2
ICP	200.7	1	6 ug/L	6 months	500 mL P,G	HNO, to pH<2
flame	3010/7210	3	0.02 mg/L	6 months	500 mL P,G	HNO, to pH<2
furnace	3020/7211	3	1 ug/L	6 months	500 mL P,G	HNO, to pH<2
ICP	3010/6010	3	6 ug/L	6 months	500 mL P,G	HNO, to pH<2
Gold						
flame	231.1	1	0.1 mg/L	6 months	500 mL P,G	HNO, to pH<2
furnace	231.2	1	1 ug/L	6 months	500 mL P,G	HNO, to pH<2
Iridium						
flame	235.1	1	3 mg/L	6 months	500 mL P,G	HNO, to pH<2
furnace	235.2	1	0.03 mg/L	6 months	500 mL P,G	HNO, to pH<2
Iron						
flame	236.1	1	0.03 mg/L	6 months	500 mL P,G	HNO, to pH<2
furnace	236.2	1	1 ug/L	6 months	500 mL P,G	HNO, to pH<2
ICP	200.7	1	7 ug/L	6 months	500 mL P,G	HNO, to pH<2
flame	3010/7380	3	0.03 mg/L	6 months	500 mL P,G	HNO, to pH<2
furnace	3020/7381	3	1 ug/L	6 months	500 mL P,G	HNO, to pH<2
ICP	3010/6010	3	7 ug/L	6 months	500 mL P,G	HNO, to pH<2

1/ Polyethylene (P) or glass (G) with required minimum collection volume. All glass containers must have Teflon-lined caps.

WATER MATRIX

		Method Prep/Analysis	Ref	Method Detection Limit	Holding Time	Container 1/	Perservative
METALS ANALYSIS							
Lead							
	flame	239.1	1	0.1 mg/L	6 months	500 mL P,G	HNO_3 to pH<2
	furnace	239.2	1	1 ug/L	6 months	500 mL P,G	HNO_3 to pH<2
	ICP	200.7	1	42 ug/L	6 months	500 mL P,G	HNO_3 to pH<2
	flame	3010/7420	3	0.1 mg/L	6 months	500 mL P,G	HNO_3 to pH<2
	furnace	3020/7421	3	1 ug/L	6 months	500 mL P,G	HNO_3 to pH<2
	ICP	3010/6010	3	42 ug/L	6 months	500 mL P,G	HNO_3 to pH<2
Magnesium							
	flame	242.1	1	0.001 mg/L	6 months	500 mL P,G	HNO_3 to pH<2
	ICP	200.7	1	30 ug/L	6 months	500 mL P,G	HNO_3 to pH<2
	flame	3010/7450	3	0.001 mg/L	6 months	500 mL P,G	HNO_3 to pH<2
	ICP	3010/6010	3	30 ug/L	6 months	500 mL P,G	HNO_3 to pH<2
Manganese							
	flame	243.1	1	0.01 mg/L	6 months	500 mL P,G	HNO_3 to pH<2
	furnace	243.2	1	0.2 ug/L	6 months	500 mL P,G	HNO_3 to pH<2
	ICP	200.7	1	2 ug/L	6 months	500 mL P,G	HNO_3 to pH<2
	flame	3010/7460	3	0.01 mg/L	6 months	500 mL P,G	HNO_3 to pH<2
	furnace	3020/7461	3		6 months	500 mL P,G	HNO_3 to pH<2
	ICP	3010/6010	3	2 ug/L	6 months	500 mL P,G	HNO_3 to pH<2
Mercury							
	cold vapor, manual	245.1	1	0.0002 mg/L	28 days	500 mL P,G	HNO_3 to pH<2
	cold vapor, automated	245.2	1	0.0002 mg/L	28 days	500 mL P,G	HNO_3 to pH<2
	cold vapor, manual	7470	3	0.0002 mg/L	28 days	500 mL P,G	HNO_3 to pH<2
Molybdenum							
	flame	246.1	1	0.1 mg/L	6 months	500 mL P,G	HNO_3 to pH<2
	furnace	246.2	1	1 ug/L	6 months	500 mL P,G	HNO_3 to pH<2
	ICP	200.7	1	8 ug/L	6 months	500 mL P,G	HNO_3 to pH<2
	flame	3010/7480	3	0.1 mg/L	6 months	500 mL P,G	HNO_3 to pH<2
	furnace	3020/7481	3	1 ug/L	6 months	500 mL P,G	HNO_3 to pH<2
	ICP	3010/6010	3	8 ug/L	6 months	500 mL P,G	HNO_3 to pH<2
Nickel							
	flame	249.1	1	0.04 mg/L	6 months	500 mL P,G	HNO_3 to pH<2
	furnace	249.2	1	1 ug/L	6 months	500 mL P,G	HNO_3 to pH<2
	ICP	200.7	1	15 ug/L	6 months	500 mL P,G	HNO_3 to pH<2
	flame	3010/7520	3	0.04 mg/L	6 months	500 mL P,G	HNO_3 to pH<2
	ICP	3010/6010	3	15 ug/L	6 months	500 mL P,G	HNO_3 to pH<2
Osmium							
	flame	252.1	1	0.3 mg/L	6 months	500 mL P,G	HNO_3 to pH<2
	furnace	252.2	1	20 ug/L	6 months	500 mL P,G	HNO_3 to pH<2
	flame	3010/7550	3	0.3 mg/L	6 months	500 mL P,G	HNO_3 to pH<2
Palladium							
	flame	253.1	1	0.1 mg/L	6 months	500 mL P,G	HNO_3 to pH<2
	furnace	253.2	1	5 ug/L	6 months	500 mL P,G	HNO_3 to pH<2
	ICP	200.7	1				

1/ Polyethylene (P) or glass (G) with required minimum collection volume. All glass containers must have Teflon-lined caps.

WATER MATRIX

		Method Prep/Analysis	Ref	Method Detection Limit	Holding Time	Container 1/	Perservative
METALS ANALYSIS							
Platinum							
	flame	255.1	1	0.2 mg/L	6 months	500 mL P,G	HNO_3 to pH<2
	furnace	255.2	1	0.02 mg/L	6 months	500 mL P,G	HNO_3 to pH<2
Potassium							
	flame	258.1	1	0.01 mg/L	6 months	500 mL P,G	HNO_3 to pH<2
	ICP	200.7	1	variable 2/	6 months	500 mL P,G	HNO_3 to pH<2
	flame	3010/7610	3	0.01 mg/L	6 months	500 mL P,G	HNO_3 to pH<2
	ICP	3010/6010	3	variable 2/	6 months	500 mL P,G	HNO_3 to pH<2
Rhenium							
	flame	264.1	1	5 mg/L	6 months	500 mL P,G	HNO_3 to pH<2
	furnace	264.2	1	0.2 mg/L	6 months	500 mL P,G	HNO_3 to pH<2
Rhodium							
	flame	265.1	1	0.05 mg/L	6 months	500 mL P,G	HNO_3 to pH<2
	furnace	265.2	1	5 ug/L	6 months	500 mL P,G	HNO_3 to pH<2
Ruthenium							
	flame	267.1	1	0.2 mg/L	6 months	500 mL P,G	HNO_3 to pH<2
	furnace	267.2	1	0.02 mg/L	6 months	500 mL P,G	HNO_3 to pH<2
Selenium							
	ICP	200.7	1	75 ug/L	6 months	500 mL P,G	HNO_3 to pH<2
	furnace	270.2	1	2 ug/L	6 months	500 mL P,G	HNO_3 to pH<2
	AA, Hydride	270.3	1	2 ug/L	6 months	500 mL P,G	HNO_3 to pH<2
	ICP	3010/6010	3	75 ug/L	6 months	500 mL P,G	HNO_3 to pH<2
	furnace	3020/7740	3	2 ug/L	6 months	500 mL P,G	HNO_3 to pH<2
	AA, Hydride	7741	3	0.002 mg/L	6 months	500 mL P,G	HNO_3 to pH<2
Silica							
	ICP	200.7	1	58 ug/L	28 days	500 mL P,G	cool 4° C
	ICP	3010/6010	3	58 ug/L	28 days	500 mL P,G	cool 4° C
Silver	flame	272.1	1	0.01 mg/L	6 months	500 mL P,G	HNO_3 to pH<2
	furnace	272.2	1	0.2 ug/L	6 months	500 mL P,G	HNO_3 to pH<2
	ICP	200.7	1	7 ug/L	6 months	500 mL P,G	HNO_3 to pH<2
	flame	3010/7760	3	0.01 mg/L	6 months	500 mL P,G	HNO_3 to pH<2
	furnace	3020/7761	3	0.2 ug/L	6 months	500 mL P,G	HNO_3 to pH<2
	ICP	3010/6010	3	7 ug/L	6 months	500 mL P,G	HNO_3 to pH<2
Sodium							
	flame	273.1	1	0.002 mg/L	6 months	500 mL P,G	HNO_3 to pH<2
	ICP	200.7	1	29 ug/L	6 months	500 mL P,G	HNO_3 to pH<2
	flame	3010/7770	3	0.002 mg/L	6 months	500 mL P,G	HNO_3 to pH<2
	ICP	3010/6010	3	29 ug/L	6 months	500 mL P,G	HNO_3 to pH<2

1/ Polyethylene (P) or glass (G) with required minimum collection volume. All glass containers must have Teflon-lined caps.

WATER MATRIX

		Method Prep/Analysis	Ref	Method Detection Limit	Holding Time	Container 1/	Perservative
METALS ANALYSIS							
Thallium							
	flame	279.1	1	0.1 mg/L	6 months	500 mL P,G	HNO, to pH<2
	furnace	279.2	1	1 ug/L	6 months	500 mL P,G	HNO, to pH<2
	ICP	200.7	1	40 ug/L	6 months	500 mL P,G	HNO, to pH<2
	flame	3010/7840	3	0.1 mg/L	6 months	500 mL P,G	HNO, to pH<2
	furnace	3020/7841	3	1 ug/L	6 months	500 mL P,G	HNO, to pH<2
	ICP	3010/6010	3	40 ug/L	6 months	500 mL P,G	HNO, to pH<2
Tin							
	flame	282.1	1	0.8 mg/L	6 months	500 mL P,G	HNO, to pH<2
	furnace	282.2	1	5 ug/L	6 months	500 mL P,G	HNO, to pH<2
	flame	3010/7870	3	0.8 mg/L	6 months	500 mL P,G	HNO, to pH<2
Titanium							
	flame	283.1	1	0.4 mg/L	6 months	500 mL P,G	HNO, to pH<2
	furnace	283.2	1	10 ug/L	6 months	500 mL P,G	HNO, to pH<2
Vanadium							
	flame	286.1	1	0.2 mg/L	6 months	500 mL P,G	HNO, to pH<2
	furnace	286.2	1	4 ug/L	6 months	500 mL P,G	HNO, to pH<2
	ICP	200.7	1	8 ug/L	6 months	500 mL P,G	HNO, to pH<2
	flame	3010/7910	3	0.2 mg/L	6 months	500 mL P,G	HNO, to pH<2
	furnace	3020/7911	3	4 ug/L	6 months	500 mL P,G	HNO, to pH<2
	ICP	3010/6010	3	8 ug/L	6 months	500 mL P,G	HNO, to pH<2
Zinc	flame	289.1	1	0.005 mg/L	6 months	500 mL P,G	HNO, to pH<2
	furnace	289.2	1	0.05 ug/L	6 months	500 mL P,G	HNO, to pH<2
	ICP	200.7	1	2 ug/L	6 months	500 mL P,G	HNO, to pH<2
	flame	3010/7950	3	0.005 mg/L	6 months	500 mL P,G	HNO, to pH<2
	furnace	3020/7951	3	0.05 ug/L	6 months	500 mL P,G	HNO, to pH<2
	ICP	3010/6010	3	2 ug/L	6 months	500 mL P,G	HNO, to pH<2

1/ Polyethylene (P) or glass (G) with required minimum collection volume. All glass containers must have Teflon-lined caps.

WATER MATRIX

	Method Prep/Analysis	Ref	Method Detection Limit	Holding Time	Container [1/]	Perservative
INORGANICS, NON-METALS						
Acidity						
titrimetric	305.1	1	0.1 mg/L,$CaCO_3$	14 days	100 mL P,G	cool, 4 °C
Alkalinity						
titrimetric	310.1	1	0.1 mg/L,$CaCO_3$	14 days	100 mL P,G	cool 4 °C
Bromide						
titrimetric	320.1	1	0.1 mg/L, Br	28 days	100 mL P,G	none required
Chloride						
colorimetric	325.2	1	0.1 mg/L, Cl	28 days	50 mL P,G	none required
colorimetric	9250	3	ask lab	28 days	50 mL P,G	none required
Chloride titrimetric	9252	3	ask lab	28 days	50 mL P,G	none required
colorimetric	9251	3	ask lab	28 days	50 mL P,G	none required
Chlorine, total residual						
amperometric	330.1	1	0.1 mg/L, Cl	analyze immed.	200 mL P,G	none required
titrimetric, Iodometric	330.3	1	0.1 mg/L, Cl	analyze immed.	200 mL P,G	none required
DPD-FAS	330.4	1	0.1 mg/L, Cl	analyze immed.	200 mL P,G	none required
Spectrophotometric	330.5	1	0.1 mg/L, Cl	analyze immed.	200 mL P,G	none required
Coliform, total						
fermentation	9131	3	ask laboratory	6 hrs (ww)[3/] 30 hrs (dw)[4/]	100 mL P	cool 4° C
membrane filter	9132	3	ask laboratory	6 hrs (ww) 30 hrs (dw)	100 mL P	cool 4° C
Cyanide[2/]						cool 4 °C[2/] and
amenable to chlorine	335.1	1	0.002 ug/L	14 days	500 mL P,G	NaOH to pH>12
spectrophotometric	335.2	1	0.002 ug/L	14 days	500 mL P,G	NaOH to pH>12
total, UV	335.3	1	0.002 ug/L	14 days	500 mL P,G	NaOH to pH>12
weak acid dissociable	9010	3	ask lab	14 days	500 mL P,G	NaOH to pH>12
colorimetric	9012	3	ask lab	14 days	500 mL P,G	NaOH to pH<12
Fluoride						
distillation	340.1	1	0.1 mg/L, F	28 days	300 mL P,G	none required
ion selective electrode	340.2	1	0.1 mg/L, F	28 days	300 mL P,G	none required
colorimetric	340.3	1	0.01 mg/L, F	28 days	300 mL P,G	none required
Iodide titrimetric	345.1	1	0.1 mg/L, I	24 hours	100 mL P,G	cool, 4 °C

1/ Polyethylene (P) or glass (G) with required minimum collection volume. All glass containers must have Teflon-lined caps.
2/ Samples should be tested for the presence of sulfide with lead acetate paper and for presence of oxidizers with potato starch paper prior to preservation in the field. Samples showing positive results must be appropriately treated prior to preservation or analyzed within 24 hours of collection.
3/ waste water
4/ drinking water

WATER MATRIX

	Method Prep/Analysis	Ref	Method Detection Limit	Holding Time	Container 1/	Perservative
INORGANICS, NON-METALS CONTINUED						
Nitrogen						
Ammonia						cool, 4 °C and
colorimetric, phenate	350.1	1	0.01 mg/L	28 days	400 mL P,G	H_2SO_4 to pH<2
distillation	350.2	1	0.01 mg/L	28 days	400 mL P,G	H_2SO_4 to pH<2
ion selective electrode	350.3	1	0.01 mg/L	28 days	400 mL P,G	H_2SO_4 to pH<2
Kjeldahl, total						cool, 4 °C and
colorimetric, phenate	351.1	1	0.01 mg/L, N	28 days	500 mL P,G	H_2SO_4 to pH<2
block digester	351.2	1	0.1 mg/L, N	28 days	500 mL P,G	H_2SO_4 to pH<2
colorimetric, titrimetric, potentiometric	351.3	1	0.01 mg/L, N	28 days	500 mL P,G	H_2SO_4 to pH<2
ion selective electrode	351.4	1	0.01 mg/L, N	28 days	500 mL P,G	H_2SO_4 to pH<2
Methylene blue colorimetric Active Subtances (MBAs) - surfactants	425.1	1		48 hours	500 mL P,G	cool, 4 °C
Nitrate						
colorimetric, brucine	352.1	1	0.1 mg/L NO_3	48 hours	100 mL P,G	cool, 4 °C
	9200	3		48 hours	100 mL P,G	cool, 4 °C
Nitrate-Nitrite						
colorimetric, hydrazine	353.1	1	0.01 mg/L as N	28 days	100 mL P,G	cool, 4 °C and H_2SO_4 to pH<2
cadmium reduction, auto	353.2	1	0.01 mg/L as N	28 days	100 mL P,G	H_2SO_4 to pH<2
cadmium reduction, manual	353.3	1	0.01 mg/L as N	28 days	100 mL P,G	H_2SO_4 to pH<2
Nitrite						
spectrophotometric	354.1	1	0.01 mg/L NO_2	48 hours	50 mL P,G	cool, 4 °C
Oxygen, Dissolved						
membrane electrode	360.1	1	0.05 mg/L	analyze immed.	300 mL G	none required
winkler	360.2	1	0.05 mg/L	8 hours	300 mL G	fix, on site store in dark
Phosphorus						cool, 4 °C
(hydrolyzable and total) colorimetric, auto	365.1	1	0.01 mg/L, P	28 days	50 mL P,G	H_2SO_4 to pH<2
colorimetric, single rgt	365.2	1	0.01 mg/L, P	28 days	50 mL P,G	H_2SO_4 to pH<2
colorimetric two rgt	365.3	1	0.01 mg/L, P	28 days	50 mL P,G	H_2SO_4 to pH<2
total, auto, block digester AAII	365.4	1	0.01 mg/L, P	28 days	50 mL P,G	H_2SO_4 to pH<2
Ortho-phosphate, Dissolved	365.1,365.2	1		48 hours	50 mL P,G	cool, 4 °C
	365.3	1			Filter on site	
Total, phosphorous	365.4	1		28 days	50 mL P,G	cool, 4 °C and H_2SO_4 to pH<2
Silica						
colorimetric	370.1	1	0.1 mg/L	28 days	50 mL P only	cool, 4 °C

1/ Polyethylene (P) or glass (G) with required minimum collection volume. All glass containers must nave Teflon-lined caps.

WATER MATRIX

		Method Prep/Analysis	Ref	Method Detection Limit	Holding Time	Container 1/	Perservative
INORGANICS, NON-METALS CONTINUED							
Sulfate							
	ion chromatograph	300.0	1		28 days	50 mL P,G	cool, 4 °C
	colorimetric	375.1	1	0.1 mg/L	28 days	50 mL P,G	cool, 4 °C
	gravimetric	375.3	1	10 mg/L	28 days	50 mL P,G	cool, 4 °C
	turbidimetric	375.4	1	1 mg/L	28 days	50 mL P,G	cool, 4 °C
	colorimetric	9035	3	0.1 mg/L	28 days	50 mL P,G	cool, 4 °C
	colorimetric	9036	3	0.1 mg/L	28 days	50 mL P,G	cool, 4 °C
	turbidimetric	9038	3	1.0 mg/L	28 days	50 mL P,G	cool, 4 °C
Sulfide							
	titrimetric	376.1	1	1 mg/L	7 days	500 mL P,G	cool, 4 °C and ZnAc/NaOH to pH>9
	colorimetric	376.2	1	1 mg/L	7 days	500 mL P,G	cool, 4 °C and ZnAc/NaOH to pH>9
	colorimetric	9030	3	1 mg/L	7 days	500 mL P,G	cool, 4 °C and ZnAc/NaOH to pH>9
Sulfite							
	titrimetric	377.1	1	2 mg/L	analyze immed.	50 mL P,G	none required
Radio Nuclides							
	radium 228	9820	3	ask laboratory	6 months	1 gallon P,G	HNO, to pH<2
	Gross alpha, gross beta	9310	3	ask laboratory	6 months	1 gallon P,G	HNO, to pH<2
	Alpha emitting radium isotopes	9315	3		6 months	1 gallon P,G	HNO, to pH<2
	others -						

1/ Polyethylene (P) or glass (G) with required minimum collection volume. All glass containers must have Teflon-lined caps.

WATER MATRIX

	Method Prep/Analysis	Ref	Method Detection Limit	Holding Time	Container [1/]	Perservative
ORGANICS						
Biochemical Oxygen Demand (BOD)						
5 days,20 °C	405.1	1	5 mg/L	48 hours	1000 mL P,G	cool, 4 °C
Chemical Oxygen Demand (COD)						
titrimetric, mid level	410.1	1	50 mg/L	28 days	50 mL P,G	cool, 4 °C and H_2SO_4 to pH<2
titrimetric, low level	410.2	1	5 mg/L	28 days	50 mL P,G	cool, 4 °C and H_2SO_4 to pH<2
titrimetric, high level (automated)	410.3	1	250 mg/L	28 days	50 mL P,G	cool, 4 °C and H_2SO_4 to pH<2
colorimetric	410.4	1	3 mg/L	28 days	50 mL P,G	cool, 4 °C and H_2SO_4 to pH<2
Oil and Grease, Total						
gravimetric	413.1	1	5 mg/L	28 days	1000 mL G	H_2SO_4 to pH<2 only
spectrometric	413.2	1	0.2 mg/L	28 days	1000 mL G	H_2SO_4 to pH<2 only
	9070	3	ask lab	28 days	1000 mL G	H_2SO_4 to pH<2 only
Total Organic Carbon (TOC)						
combustion or oxidation	415.1	1	1 mg/L	28 days	25 mL P,G	cool, 4 °C H_2SO_4 or HCL to pH<2
	9060	3		28 days	25 mL P,G	cool, 4 °C H_2SO_4 or HCL to pH<2
Petroleum Hydrocarbons (Total Recoverable) spectrophotometric	418.1	1	1 mg/L	14 days [2/]	1 liter G	5 mL HCl cool, 4° C
Phenolics, Total Recoverable						
spectrophotometric	420.1	1	5 ug/L	28 days	500 mL G	cool, 4 °C H_2SO_4 to pH<2 only
colormetric	420.2	1	2 ug/L	28 days	500 mL G	H_2SO_4 to pH<2 only
	9065	3	ask lab	28 days	500 mL G only	H_2SO_4 to pH<2
	9066	3	ask lab	28 days	500 mL G only	H_2SO_4 to pH<2
	9067	3	ask lab	28 days	500 mL G only	H_2SO_4 to pH<2
Halogenated Volatile Organics						
gas chromotography	601	2	1-5 ug/L	14 days	2x40 mL G vial with Teflon septa	cool, 4° C
gas chrom.	5030/8010	3	1-5 ug/L	14 days	2x40 mL G vial with Teflon septa	cool, 4° C
Non-halogenated Volatile Organics						
gas chrom.	5030/8015	3	10 ug/L	14 days	2x40 mL G vial with Teflon septa	HCl to pH<2 cool, 4° C

1/ Polyethylene (P) or glass (G) with required minimum collection volume. All glass containers must have Teflon-lined caps.

2/ No actual holding time is published or promulated in 40 CFR 136. This holding time seems to be most reasonable.

WATER MATRIX

	Method Prep/Analysis	Ref	Method Detection Limit	Holding Time	Container 1/	Perservative
ORGANICS CONTINUED						
Purgeable Aromatics						
gas chromotography	602	2	1-5 ug/L	14 days	2x40 mL G vial with Teflon septa	HCl to pH<2 cool, 4° C
gas chrom.	5030/8020	3	1-5 ug/L	14 days	2x40 mL G vial with Teflon septa	HCl to pH<2 cool, 4° C
Acrolein and Acrylonitrile						
gas chromotography	603	2	1 ug/L	14 days	2x40 mL G vial with Teflon septa	HCl to pH 5 cool, 4° C
gas chrom.	5030/8030	3	1 ug/L	14 days	2x40 mL G vial with Teflon septa	HCl to pH 5 cool, 4° C
Phenols gas chromotography	604	2	1-20 ug/L	7 days extn. 40 days anal.	1 L, amber G1/	cool, 4 °C
gas chrom.	3510/3520/8040	3	1-20 ug/L	7 days extn. 40 days anal.	1 L, amber G1/	cool, 4 °C
Benzidines gas chromotography	605	2	1 ug/L	7 days extn. 40 days anal.	1 L, amber G1/	cool, 4 °C
Phthalate Esters						
gas chromotography	606	2	1-5 ug/L	7 days extn. 40 days anal.	1 L, amber G1/	cool, 4 °C
gas chrom.	3510/3520/8060	3	1-5 ug/L	7 days extn. 40 days anal.	1 L, amber G1/	cool, 4 °C
Nitrosamines gas chromotography	607	2	1 ug/L	7 days extn. 40 days anal.	1 L, amber G1/	cool, 4 °C
Pesticides and PCBs (Organochlorine)						
gas chromotography	608	2	0.001-0.1 ug/L	7 days extn. 40 days anal.	1 L, amber G1/	cool, 4 °C
gas chrom.	3510/3520/8080	3	0.001-0.1 ug/L 40 days anal.	7 days extn.	1 L, amber G1/	cool, 4 °C
Ethylene Dibromide (EDB)						
gas chromotography	601M2/	2	0.02 mg/L	14 days	2x40 ml G vial with Teflon septa	cool, 4° C
	504.1	1	0.02 mg/L	14 days	2x40 ml G vial with Teflon septa	cool, 4° C
Nitroaromatics and Isophorone						
gas chromotography	609	2	3-20 ug/L	7 days extn. 40 days anal.	1 L, amber G1/	cool, 4 °C
gas chrom.	3510/3520/8090	3	3-20 ug/L	7 days extn. 40 days anal.	1 L, amber G1/	cool, 4 °C
Polynuclear Aromatic Hydrocarbons						
gas chromotography	610	2	0.01-5 ug/L	7 days extn. 40 days anal.	1 L, amber G1/	cool, 4 °C
gas chrom	3510/3520/8100	3	0.01-5 ug/L	7 days extn. 40 days anal.	1 L, amber G1/	cool, 4 °C
HPLC	8310	3		7 days extn. 40 days anal.	1 L, amber G1/	cool, 4 °C
Haloethers gas chromotography	611	2	1-5 ug/L	7 days extn. 40 days anal.	1 L, amber G1/	cool, 4 °C

1/ Polyethylene (P) or glass (G) with required minimum collection volume. All glass containers must have Teflon-lined caps.
2/ Method 601M is modified 601 by the substitution of an election capture detector for the Hall electrolytic conductivity detectior.

WATER MATRIX

	Method Prep/Analysis	Ref	Method Detection Limit	Holding Time	Container [1/]	Perservative
ORGANICS CONTINUED						
Chlorinated Hydrocarbons						
gas chromotography	612	2	0.01-2 ug/L	7 days extn. 40 days anal.	1 L, amber G[1/]	cool, 4 °C
gas chrom.	3510/3520/8120	3	0.01-2 ug/L	7 days extn. 40 days anal.	1 L, amber G[1/]	cool, 4 °C
Organophosphorus Pesticides						
gas chrom.	3510/3520/8140	3	0.1-5 ug/L	7 days extn. 40 days anal.	1 L, G only[1/]	cool, 4 °C
2,3,7,8-Tetrachlorodibenzo-p-dioxin						
gas chromotography	613	2	0.002 ug/L	7 days extn. 40 days anal.	1 L, G only[1/]	cool, 4 °C
Chlorinated Herbicides						
gas chromotography	8150	3	0.1-200 ug/L	7 days extn. 40 days anal.	1 L, G only	cool, 4 °C
Purgeables (GC/MS)	624	2	1-5 ug/L	14 days[2/]	2x40 mL G vial with Teflon septa	cool, 4 °C and HCl to pH <2
624 List plus Acrolein and Acrylonitrile	624 624	2 2		14 days[2/]	2x40 mL G vial with Teflon septa	cool, 4 °C and HCl to pH<2[2/]
Priority Pollutant List	624	2		14 days[2/]	2x40 mL G vial with Teflon septa	cool, 4 °C and HCl to pH<2[2/]
Target Compound List (EPA/CLP)	624	2		14 days[2/]	2x40 mL G vial with Teflon septa	cool, 4 °C and HCl to pH<2[2/]
Appendix IX List	624	2		14 days[2/]	2x40 mL G vial with Teflon septa	cool, 4 °C and HCl to pH<2[2/]
Priority Pollutant List	5030/8240	3	1-5 ug/L	14 days[2/]	2x40 mL G vial with Teflon septa	cool, 4 °C and HCl to pH<2[2/]
Hazardous Substance List (EPA/CLP)	5030/8240	3		14 days[2/]	2x40 mL G vial with Teflon septa	cool, 4 °C and HCl to pH<2[2/]
Appendix IX List	5030/8240	3		14 days[2/]	2x40 mL G vial with Teflon septa	cool, 4 °C and HCl to pH<2[2/] vial
Base/Neutrals, Acids, Pesticides (GC/MS)						
625 List	625	2	1-50 ug/L	7 days extn. 40 days anal.	1 L, G only	cool, 4 °C
Priority Pollutants List	625	2		7 days extn. 40 days anal.	1 L, G only	cool, 4 °C
Target Compound List (EPA/CLP)	625	2		7 days extn. 40 days anal.	1 L, G only	cool, 4 °C
Appendix IX List	625	2		7 days extn. 40 days anal.	1 L, G only	cool, 4 °C
Priority Pollutants List	3510/3520/8250	3	1-5 ug/L	7 days extn. 40 days anal.	1 L, G only	cool, 4 °C

1/ Polyethylene (P) or glass (G) with required minimum collection volume. All glass containers must have Teflon-lined caps.

2/ Holding time is 7 days for purgeable aromatic compounds if the sample is not preserved with acid.

WATER MATRIX

	Method Prep/Analysis	Ref	Method Detection Limit	Holding Time	Container 1/	Perservative
ORGANICS CONTINUED						
Hazardous Substance List (EPA/CLP)	3510/3520/8250	3		7 days extn. 40 days anal.	1 L, G only	cool, 4 °C
Appendix IX List	3510/3520/8250	3		7 days extn. 40 days anal.	1 L, G only	cool, 4 °C
Priority Pollutants List	3510/3520/8270	3	1-5 ug/L	7 days extn. 40 days anal.	1 L, G only	cool, 4 °C
Target Compound List (EPA/CLP)	3510/3520/8250	3		7 days extn. 40 days anal.	1 L, G only	cool, 4 °C
Appendix IX List				7 days extn. 40 days anal.	1 L, G only	cool, 4 °C
Total Organic Halides (TOX)	9020	3		28 days	1 L, G only	cool, 4 °C
TOX	9022	3		28 days	1 L, G only	cool, 4 °C

1/ Polyethylene (P) or glass (G) with required minimum collection volume. All glass containers must have Teflon-lined caps.
2/ Holding time is 7 days for purgeable aromatic compounds if the sample is not preserved with acid.

SECTION 3.0

GUIDE TO METHODS

SOLID/SEMISOLID MATRIX

SOLID\SEMISOLID\SLUDGE\WASTE MATRIX

	Method Prep/Analysis	Ref	Holding Time	Container[1/]	Preservation
PHYSICAL PROPERTIES					
pH	9040	3	ASAP [2/]	100 g, P,G	cool, 4 °C
	9040	3	ASAP	100 g, P,G	cool, 4 °C
Specific conductance	9050	3	ASAP	100 g, P,G	cool, 4 °C
Ignitability			ASAP	100 g, P,G	cool, 4 °C
Pensky-Martens	1010	3	ASAP	100 g, P,G	cool, 4 °C
Setaflash	1020	3	ASAP	100 g, P,G	cool, 4 °C
Corrosivity	1110	3	ASAP	100 g, P,G	cool, 4 °C
Reactivity			ASAP	100 g, P,G	cool, 4 °C
Cyanide	7.3.3.2	3	ASAP	100 g, P,G	cool, 4 °C
Sulfide	7.3.4.1	3	ASAP	100 g, P,G	cool, 4 °C
E.P. Toxicity			ASAP	100 g, P,G	cool, 4 °C
Eight RCRA Metals	1310	3	ASAP	100 g, P,G	cool, 4 °C
Current Complete EPTOX List			ASAP	100 g, P,G	cool, 4 °C
TCLP	1311	3	ASAP	100 g, P,G	cool, 4 °C
				100 g, P,G	cool, 4 °C
Metals except mercury	180 days TCLP extn/180 days prep extn analysis (360)			100 g, P,G	cool, 4 °C
Mercury	28 days TCLP extn/28 days prep extn analysis (56)				
Volatile Organics	14 days TCLP extn/14 days to analysis (28)			100 g, P,G	cool, 4 °C
Semivolatile Organic Organics	14 days TCLP extn/7 days to prep extn/40 days analysis (61)			100 g, P,G	cool, 4 °C
Pesticides	same as semivolatiles			100 g, P,G	cool, 4 °C
Cation Exchange Capacity			ASAP	100 g, P,G	cool, 4 °C
ammonium acetate	9080	3	ASAP	100 g, P,G	cool, 4 °C
sodium acetate	9081	3	ASAP	100 g, P,G	cool, 4 °C
SAMPLE PREPARATION METHODS-METALS					
Waters for Flame AA/ICP	3005	3	6 months	100 g P,G	cool, 4 °C
Aqueous/Extracts for Flame AA/ICP	3010	3	6 months	100 g P,G	cool, 4 °C
Aqueous/Extracts for Furnace AA	3020	3	6 months	100 g P,G	cool, 4 °C
Sediments, Sludges, and Soils	3050	3	analyze immed.	100 g P,G	cool, 4 °C
Dissolution (Oil, Grease)	3040	3	analyze immed.	100 g P,G	none required
SAMPLE ANALYSIS METHODS-METALS					
Aluminum flame	7020	3	6 months	100 g, P,G	cool, 4 °C
ICP	6010	3	6 months	100 g, P,G	cool, 4 °C
Antimony flame	7040	3	6 months	100 g, P,G	cool, 4 °C
furnace	7041	3	6 months	100 g, P,G	cool, 4 °C
ICP	6010	3	6 months	100 g, P,G	cool, 4 °C

1/ Polyethylene (P) or glass (G) container with required minimum collection volume. All glass containers have Teflon-lined caps or Teflon septums in the cap.
2/ As soon as possible.

SOLID\SEMISOLID\SLUDGE\WASTE MATRIX

	Method Prep/Analysis		Ref	Holding Time	Container[1/]	Preservation
METALS ANALYSIS CONTINUED						
Arsenic	ICP	6010	3	6 months	100 g, P,G	cool, 4 °C
	furnace	7060	3	6 months	100 g, P,G	cool, 4 °C
	AA, Hydride	7061	3	6 months	100 g, P,G	cool, 4 °C
Barium	flame	7080	3	6 months	100 g, P,G	cool, 4 °C
	furnace	7081	3	6 months	100 g, P,G	cool, 4 °C
	ICP	6010	3	6 months	100 g, P,G	cool, 4 °C
Beryllium	flame	7090	3	6 months	100 g, P,G	cool, 4 °C
	furnace	7091	3	6 months	100 g, P,G	cool, 4 °C
	ICP	6010	3	6 months	100 g, P,G	cool, 4 °C
Boron	ICP	6010	3	6 months	100 g, P,G	cool, 4 °C
Cadmium	flame	7130	3	6 months	100 g, P,G	cool, 4 °C
	furnace	7131	3	6 months	100 g, P,G	cool, 4 °C
	ICP	6010	3	6 months	100 g, P,G	cool, 4 °C
Calcium	flame	7140	3	6 months	100 g, P,G	cool, 4 °C
	ICP	6010	3	6 months	100 g, P,G	cool, 4 °C
Chromium	flame	7190	3	6 months	100 g, P,G	cool, 4 °C
	furnace	7191	3	6 months	100 g, P,G	cool, 4 °C
	ICP	6010	3	6 months	100 g, P,G	cool, 4 °C
Chromium, Hexavalent						
	coprecipitation	7195	3	24 hours	100 g, P,G	cool, 4 °C
	colorimetric	7196	3	24 hours	100 g, P,G	cool, 4 °C
	chelation/ extraction	7197	3	24 hours	100 g, P,G	cool, 4 °C
	differential pulse polarography	7198	3	24 hours	100 g, P,G	cool, 4 °C
Cobalt	flame	7200	3	6 months	100 g, P,G	cool, 4 °C
	furnace	7201	3	6 months	100 g, P,G	cool, 4 °C
	ICP	6010	3	6 months	100 g, P,G	cool, 4 °C
Copper	flame	7210	3	6 months	100 g, P,G	cool, 4 °C
	furnace	7211	3	6 months	100 g, P,G	cool, 4 °C
	ICP	6010	3	6 months	100 g, P,G	cool, 4 °C
Iron	flame	7380	3	6 months	100 g, P,G	cool, 4 °C
	furnace	7381	3	6 months	100 g, P,G	cool, 4 °C
	ICP	6010	3	6 months	100 g, P,G	cool, 4 °C
Lead	flame	7420	3	6 months	100 g, P,G	cool, 4 °C
	furnace	7421	3	6 months	100 g, P,G	cool, 4 °C
	ICP	6010	3	6 months	100 g, P,G	cool, 4 °C
Magnesium	flame	7450	3	6 months	100 g, P,G	cool, 4 °C
	ICP	6010	3	6 months	100 g, P,G	cool, 4 °C
Manganese	flame	7460	3	6 months	100 g, P,G	cool, 4 °C
	furnace	7461	3	6 months	100 g, P,G	cool, 4 °C
	ICP	6010	3	6 months	100 g, P,G	cool, 4 °C

1/ Polyethylene (P) or glass (G) container with required minimum collection volume. All glass containers have Teflon-lined caps Teflon septums in the cap.

SOLID\SEMISOLID\SLUDGE\WASTE MATRIX

	Method Prep/Analysis		Ref	Holding Time	Container[1/]	Preservation
METALS ANALYSIS CONTINUED						
Mercury						
Liquid, Waste	cold vapor, manual	7470	3	28 days	100 g, P,G	cool, 4 °C
Solid, Semisolid Waste	cold vapor, manual	7471	3	28 days	100 g, P;G	cool, 4 °C
Molybdenum	flame	7480	3	6 months	100 g, P,G	cool, 4 °C
	furnace	7481	3	6 months	100 g, P,G	cool, 4 °C
	ICP	6010	3	6 months	100 g, P,G	cool, 4 °C
Nickel	flame	7520	3	6 months	100 g, P,G	cool, 4 °C
	furnace	7521	3	6 months	100 g, P,G	cool, 4 °C
	ICP	6010	3	6 months	100 g, P,G	cool, 4 °C
Osmium	flame	7550	3	6 months	100 g, P,G	cool, 4 °C
Potassium	flame	7610	3	6 months	100 g, P,G	cool, 4 °C
	ICP	6010	3	6 months	100 g, P,G	cool, 4 °C
Selenium	ICP	6010	3	6 months	100 g, P,G	cool, 4 °C
	furnace	7740	3	6 months	100 g, P,G	cool, 4 °C
	AA, Hydride	7741	3	6 months	100 g, P,G	cool, 4 °C
Silica	ICP	6010	3	6 months	100 g, P,G	cool, 4 °C
Silver	flame	7760	3	6 months	100 g, P,G	cool, 4 °C
	furnace	7761	3	6 months	100 g, P,G	cool, 4 °C
	ICP	6010	3	6 months	100 g, P,G	cool, 4 °C
Sodium	flame	7770	3	6 months	100 g, P,G	cool, 4 °C
	ICP	6010	3	6 months	100 g, P,G	cool, 4 °C
Thallium	flame	7840	3	6 months	100 g, P,G	cool, 4 °C
	furnace	7841	3	6 months	100 g, P,G	cool, 4 °C
	ICP	6010	3	6 months	100 g, P,G	cool, 4 °C
Tin	flame	7870	3	6 months	100 g, P,G	cool, 4 °C
Vanadium	flame	7910	3	6 months	100 g, P,G	cool, 4 °C
	furnace	7911	3	6 months	100 g, P,G	cool, 4 °C
	ICP	6010	3	6 months	100 g, P,G	cool, 4 °C
Zinc	flame	7950	3	6 months	100 g, P,G	cool, 4 °C
	furnace	7951	3	6 months	100 g, P,G	cool, 4 °C
	ICP	6010	3	6 months	100 g, P,G	cool, 4 °C

1/ Polyethylene (P) or glass (G) container with required minimum collection volume. All glass containers have Teflon-lined caps : Teflon septums in the cap.

	Method Prep/Analysis	Ref	Holding Time	Container[1/]	Preservation
ORGANICS					
GAS CHROMATOGRAPHY					
halogenated volatiles	5030/8010	3	14 days	100 g, P,G	cool, 4 °C
nonhalogenated volatiles	5030/8015	3	14 days	100 g, P,G	cool, 4 °C
aromatics	5030/8020	3	14 days	100 g, P,G	
VOCs, capillary column, PID, Hall	5030/8021	3	14 days	100 g, P,G	cool, 4 °C
acrolein, acrylonitrile, acetonitrile	5030/8030	3	14 days	500 g, P,G	cool, 4 °C
phenols	3540/3550/8040	3	14 days	500 g, G	cool, 4 °C
phthalate esters	3540/3550/8060	3	14 days	500 g, G	cool, 4 °C
pesticides/PCBs	3540/3550/8080	3	14 days	500 g, G	cool, 4 °C
nitroaromatics and cyclic ketones	3540/3550/8090	3	14 days	500 g, G	cool, 4 °C
PNAHs	3540/3550/8100	3	14 days	500 g, G	cool, 4 °C
chlorinated hydrocarbons	3540/3550/8120	3	14 days	500 g, G	cool, 4 °C
organophosphorus pesticides	3540/3550/8140	3	14 days	500 g, G	cool, 4 °C
'orinated herbicides	3540/3550/8150	3	14 days	500 g, G	cool, 4 °C
ASS SPECTROSCOPY					
volatile organics (packed)	5030/8240	3	14 days	100 g, G	cool, 4 °C
semivolatiles (packed)	3550/8250	3	14 days	500 g, G	cool, 4 °C
volatiles organics (capillary)	5030/8260	3	14 days	100 g, G	cool, 4 °C
semivolatiles (capillary)	3550/8270	3	14 days	500 g, G	cool, 4 °C
Dioxins	3540/3550/8280	3	14 days	500 g, G	cool, 4 °C
HIGH PERFORMANCE LIQUID CHROMATOGRAPHY					
PNAHs	3540/3550/8310	3	14 days	500 g, G	cool, 4 °C
MISCELLANEOUS TESTS			2/	2/	cool, 4 °C
Total and Amenable Cyanide			2/	2/	cool, 4 °C 2/
colorimetric	9010	3		2/	cool, 4 °C 2/
colorimetric/UV	9012	3	2/	2/	cool, 4 °C 2/
Total Organic Halides TOX	9020	3	2/	2/	cool, 4 °C 2/
Purgeable Organic Halides	9021	3	2/	2/	cool, 4 °C 2/
Sulfides	9030	3	2/	2/	cool, 4 °C 2/
Sulfate					
chloranilate	9035	3	28 days	100 g, P,G	cool, 4 °C
methylthymol blue/ AA II	9036	3	28 days	100 g, P,G	cool, 4 °C
turbidimetric	9038	3	28 days	100 g, P,G	cool, 4 °C
Total Organic Carbon (TOC)	9060	3	2/	2/	cool, 4 °C

1/ Polyethylene (P) or glass (G) container with required minimum collection volume. All glass containers have Teflon-lined caps c Teflon septums in the cap.
2/ Information not available; ask laboratory.

SOLID\SEMISOLID\SLUDGE\WASTE MATRIX

	Method Prep/Analysis	Ref	Holding Time	Container[1/]	Preservation
ORGANICS CONTINUED					
Phenolics			2/	2/	cool, 4 °C
spectrophotometric	9065	3	2/	2/	cool, 4 °C
colorimetric	9066	3	2/	2/	cool, 4 °C
spectrophotometric MBTH	9067	3	2/	2/	cool, 4 °C
Total Recoverable Oil and Grease (Gravimetric)	9070	3	2/	2/	cool, 4 °C
Oil and Grease Extraction	9071	3	2/	2/	cool, 4 °C
Nitrate	9200	3	28 days	250 g, P,G	none required
Chloride	9250	3	28 days	250 g, P,G	none required
Colorimetric-AA II	9251	3	28 days	250 g, P,G	none required
Titrimetric	9252	3	28 days required	250 g, P,G	none
RADIONUCLIDES			2/	2/	2/
Radium-228	9320	3	2/	2/	2/
Gross Alpha/Beta	9310	3	2/	2/	2/
Alpha-Emitting Radium Isotopes	9315	3	2/	2/	2/

1/ Polyethylene (P) or glass (G) container with required minimum collection volume. All glass containers have Teflon-lined caps Teflon septums in the cap.
2/ Information not available; ask laboratory.

METHODS REFERENCE

1/ Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020, revised March 1983.

2/ Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater, EPA-600/4-82-057, revised July 1982.

3/ Test Methods for Evaluating Solid Waste, EPA SW846, 3rd edition, revised November 1986.

4/ Standard Methods for the Examination of Water and Wastes, 17th edition, 1989.

CORPORAT\TBL\TECHFORM.W50

SECTION 4.0

STANDARDIZED ANALYTE LISTS BY CHEMICAL COMPOUND CLASS AND METHOD

EPA Method 601	Purgeable Halogenated Organics
EPA Method 602	Purgeable Aromatics
EPA Method 603	Acrolein and Acrylonitrile
EPA Method 604	Phenols
EPA Method 605	Benzidines
EPA Method 606	Phthalate Esters
EPA Method 607	Nitrosamines
EPA Method 608	Organochlorine Pesticides and PCBs
EPA Method 609	Nitroaromatics and Isophorone
EPA Method 610	Polynuclear Aromatic Hydrocarbon
EPA Method 611	Haloethers
EPA Method 612	Chlorinated Hydrocarbons
EPA Method 613	2,3,7,8-Tetrachlorodibenzo-p-dioxin
EPA Method 624	Purgeable Organics
EPA Method 625	Base/Neutral Extractables
EPA Method 625	Acid Extractables
EPA Method 8010	Halogenated Volatile Organics
EPA Method 8015	Non-halogenated Volatile Organics
EPA Method 8020	Aromatic Volatile Organics
EPA Method 8021	Volatile Organics
EPA Method 8030	Acrolein, Acrylonitrile, Acetonitrile
EPA Method 8040	Phenols
EPA Method 8060	Phthalate Esters
EPA Method 8070	Nitrosamines
EPA Method 8080	Organichlorine Pesticides and PCBs
EPA Method 8090	Nitroaromatics and Cyclic Ketones
EPA Method 8100	Polynuclear Aromatic Hydrocarbons
EPA Method 8110	Haloethers
EPA Method 8120	Chlorinated Hydrocarbons
EPA Method 8140/8141	Organophosphorus Pesticides
EPA Method 8150	Chlorinated Herbicides
EPA Method 8240	Volatile Organics
EPA Method 8250	Base/Neutral Acid Extractables
EPA Method 8260	Volatile Organics
EPA Method 8270	Base/Neutral and Acid Extractables
EPA Method 8280	Polychlorinated Dibenzo-p-dioxins and Polynuclear Dibenzofurans
EPA Method 8310	Polynuclear Aromatic Hydrocarbons

EPA METHOD 601
PURGEABLE HALOGENATED ORGANICS
BY GAS CHROMOTOGRAPHY

_____	1.	Bromodichloromethane
_____	2.	Bromoform
_____	3.	Bromomethane
_____	4.	Carbon tetrachloride
_____	5.	Chlorobenzene
_____	6.	Chloroethane
_____	7.	2-Chloroethylvinyl ether
_____	8.	Chloroform
_____	9.	Chloromethane
_____	10.	Dibromochloromethane
_____	11.	1,2-Dichlorobenzene
_____	12.	1,3-Dichlorobenzene
_____	13.	1,4-Dichlorobenzene
_____	14.	Dichlorodifluoromethane
_____	15.	1,1-Dichloroethene
_____	16.	1,2-Dichloroethane
_____	17.	1,1-Dichloroethane
_____	18.	trans-1,2-Dichloroethene
_____	19.	1,2-Dichloropropane
_____	20.	cis-1,3-Dichloropropene
_____	21.	trans-1,3-Dichloropropene
_____	22.	Methylene chloride
_____	23.	1,1,2,2-Tetrachloroethane
_____	24.	Tetrachloroethene
_____	25.	1,1,1-Trichloroethane
_____	26.	1,1,2-Trichloroethane
_____	27.	Trichloroethene
_____	28.	Trichlorofluoromethane
_____	29.	Vinyl chloride

Instructions for Use:

1. If all compounds required leave boxes blank
2. If only certain compounds are required place an X in box next to compound
3. If certain compounds should be deleted from report cross out entire compound with heavy black felt tip pen

EPA METHOD 602
PURGEABLE AROMATICS
BY GAS CHROMOTOGRAPHY
MATRIX: WATER

_____	1.	Benzene
_____	2.	Toluene
_____	3.	Ethyl benzene
_____	4.	Chlorobenzene
_____	5.	1,2-Dichlorobenzene
_____	6.	1,3-Dichlorobenzene
_____	7.	1,4-Dichlorobenzene

Instructions for Use:

1. If all compounds required leave boxes blank
2. If only certain compounds are required place an X in box next to compound
3. If certain compounds should be deleted from report cross out entire compound with heavy black felt tip pen

EPA METHOD 603
ACROLEIN AND ACRYLONITRILE
BY GAS CHROMOTOGRAPHY
MATRIX: WATER

_____	1.	Acrolein
_____	2.	Acrylonitrile

Instructions for Use:

1. If all compounds required leave boxes blank
2. If only certain compounds are required place an X in box next to compound
3. If certain compounds should be deleted from report cross out entire compound with heavy black felt tip pen

EPA METHOD 604
PHENOLS
BY GAS CHROMOTOGRAPHY
MATRIX: WATER

_____	1.	4-Chloro-3-methylphenol
_____	2.	2-Chlorophenol
_____	3.	2,4-Dichlorophenol
_____	4.	2,4-Dimethylphenol
_____	5.	2,4-Dinitrophenol
_____	6.	2-Methyl-4,6-dinitrophenol
_____	7.	2-Nitrophenol
_____	8.	4-Nitrophenol
_____	9.	Pentachlorophenol
_____	10.	Phenol
_____	11.	2,4,6-Trichlorophenol

Instructions for Use:

1. If all compounds required leave boxes blank
2. If only certain compounds are required place an X in box next to compound
3. If certain compounds should be deleted from report cross out entire compound with heavy black felt tip pen

EPA METHOD 605
BENZIDINES
BY GAS CHROMOTOGRAPHY
MATRIX: WATER

_____1. Benzidine
_____2. 3,3'-Dichlorobenzidine

Instructions for Use:

1. If all compounds required leave boxes blank
2. If only certain compounds are required place an X in box next to compound
3. If certain compounds should be deleted from report cross out entire compound with heavy black felt tip pen

EPA METHOD 606
PHTHALATE ESTERS
BY GAS CHROMOTOGRAPHY
MATRIX: WATER

_____	1.	Bis(2-ethylhexyl)phthalate
_____	2.	Butyl benzyl phthalate
_____	3.	Di-n-butyl phthalate
_____	4.	Diethyl phthalate
_____	5.	Dimethyl phthalate
_____	6.	Di-n-octyl phthalate

Instructions for Use:

1. If all compounds required leave boxes blank
2. If only certain compounds are required place an X in box next to compound
3. If certain compounds should be deleted from report cross out entire compound with heavy black felt tip pen

EPA METHOD 607
NITROSAMINES
BY GAS CHROMOTOGRAPHY
MATRIX: WATER

_____	1.	N-Nitrosodimethylamine
_____	2.	N-Nitrosodiphenylamine
_____	3.	N-Nitrosodi-n-propylamine

Instructions for Use:

1. If all compounds required leave boxes blank
2. If only certain compounds are required place an X in box next to compound
3. If certain compounds should be deleted from report cross out entire compound with heavy black felt tip pen

EPA METHOD 608
ORGANOCHLORINE PESTICIDES AND PCBs
BY GAS CHROMOTOGRAPHY
MATRIX: WATER

_____	1.	Aldrin
_____	2.	Alpha-BHC
_____	3.	Beta-BHC
_____	4.	Delta-BHC
_____	5.	Gamma-BHC (lindane)
_____	6.	Chlordane
_____	7.	4,4'-DDD
_____	8.	4,4'-DDE
_____	9.	4,4'-DDT
_____	10.	Dieldrin
_____	11.	Endosulfan I
_____	12.	Endosulfan II
_____	13.	Endosulfan sulfate
_____	14.	Endrin
_____	15.	Endrin aldehyde
_____	16.	Heptachlor
_____	17.	Heptachlor epoxide
_____	18.	Toxaphene
_____	19.	PCB-1016
_____	20.	PCB-1221
_____	21.	PCB-1232
_____	22.	PCB-1242
_____	23.	PCB-1248
_____	24.	PCB-1254
_____	25.	PCB-1260

Instructions for Use:

1. If all compounds required leave boxes blank
2. If only certain compounds are required place an X in box next to compound
3. If certain compounds should be deleted from report cross out entire compound with heavy black felt tip pen

EPA METHOD 609
NITROAROMATICS AND ISOPHORONE
BY GAS CHROMOTOGRAPHY
MATRIX: WATER

_____	1.	2,4-Dinitrotoluene
_____	2.	2,6-Dinitrotoluene
_____	3.	Isophorone
_____	4.	Nitrobenzene

Instructions for Use:

1. If all compounds required leave boxes blank
2. If only certain compounds are required place an X in box next to compound
3. If certain compounds should be deleted from report cross out entire compound with heavy black felt tip pen

EPA METHOD 610
POLYNUCLEAR AROMATIC HYDROCARBONS
BY GAS CHROMOTOGRAPHY
MATRIX: WATER

_____	1.	Acenapthene
_____	2.	Acenaphthylene
_____	3.	Anathracene
_____	4.	Benzo(a)anthracene
_____	5.	Benzo(a)pyrene
_____	6.	Benzo(b)fluoranthene
_____	7.	Benzo(ghi)perylene
_____	8.	Benzo(k)fluoranthene
_____	9.	Chrysene
_____	10.	Dibenzo(a,h)anthracene
_____	11.	Fluoranthene
_____	12.	Fluorene
_____	13.	Indeno(1,2,3-cd)pyrene
_____	14.	Naphthalene
_____	15.	Phenanthrene
_____	16.	Pyrene

Instructions for Use:

1. If all compounds required leave boxes blank

2. If only certain compounds are required place an X in box next to compound

3. If certain compounds should be deleted from report cross out entire compound with heavy black felt tip pen

EPA METHOD 611
HALOETHERS
BY GAS CHROMOTOGRAPHY
MATRIX: WATER

_____	1.	Bis(2-chloroethyl) ether
_____	2.	Bis(2-chloroethoxy) methane
_____	3.	Bis(2-chloroisopropyl) ether
_____	4.	4-Bromophenyl phenyl ether
_____	5.	4-Chlorophenyl phenyl ether

Instructions for Use:

1. If all compounds required leave boxes blank
2. If only certain compounds are required place an X in box next to compound
3. If certain compounds should be deleted from report cross out entire compound with heavy black felt tip pen

EPA METHOD 612
CHLORINATED HYDROCARBONS
BY GAS CHROMOTOGRAPHY
MATRIX: WATER

_____	1.	2-Chloronaphthalene
_____	2.	1,2-Dichlorobenzene
_____	3.	1,3-Dichlorobenzene
_____	4.	1,4-Dichlorobenzene
_____	5.	Hexachlorobenzene
_____	6.	Hexachlorobutadiene
_____	7.	Hexachlorocyclopentadiene
_____	8.	Hexachloroethane
_____	9.	1,2,4-Trichlorobenzene

Instructions for Use:

1. If all compounds required leave boxes blank
2. If only certain compounds are required place an X in box next to compound
3. If certain compounds should be deleted from report cross out entire compound with heavy black felt tip pen

EPA METHOD 613
2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN
BY GC/MASS SPECTRAL ANALYSIS
MATRIX: WATER

_____	1. 2,3,7,8-Tetrachlorodibenzo-p-dioxin

Instructions for Use:

1. If all compounds required leave boxes blank
2. If only certain compounds are required place an X in box next to compound
3. If certain compounds should be deleted from report cross out entire compound with heavy black felt tip pen

EPA METHOD 624
PURGEABLE ORGANICS
BY GC/MASS SPECTROPHOTOMETRY
MATRIX: WATER

_____	1.	Benzene
_____	2.	Bromodichloromethane
_____	3.	Bromoform
_____	4.	Bromomethane
_____	5.	Carbon tetrachloride
_____	6.	Chlorobenzene
_____	7.	Chloroethane
_____	8.	2-Chloroethylvinyl ether
_____	9.	Chloroform
_____	10.	Chloromethane
_____	11.	Dibromochloromethane
_____	12.	1,2-Dichlorobenzene
_____	13.	1,3-Dichlorobenzene
_____	14.	1,4-Dichlorobenzene
_____	15.	1,1-Dichloroethane
_____	16.	1,2-Dichloroethane
_____	17.	1,1-Dichloroethene
_____	18.	trans-1,2-Dichloroethene
_____	19.	1,2-Dichloropropane
_____	20.	cis-1,3-Dichloropropene
_____	21.	trans-1,3-Dichloropropene
_____	22.	Ethyl benzene
_____	23.	Methylene chloride
_____	24.	1,1,2,2-Tetrachloroethane
_____	25.	Tetrachloroethene
_____	26.	Toluene
_____	27.	1,1,1-Trichloroethane
_____	28.	1,1,2-Trichloroethane
_____	29.	Trichloroethene
_____	30.	Trichlorofluoromethane
_____	31.	Vinyl chloride

Instructions for Use:

1. If all compounds required leave boxes blank

2. If only certain compounds are required place an X in box next to compound

3. If certain compounds should be deleted from report cross out entire compound with heavy black felt tip pen

EPA METHOD 625
BASE/NEUTRAL EXTRACTABLES
BY GC/MASS SPECTROPHOTOMETRY
MATRIX: WATER

_____	1.	Acenaphthene
_____	2.	Acenaphthylene
_____	3.	Anthracene
_____	4.	Benzo(a)anthracene
_____	5.	Benzo(b)fluoranthene
_____	6.	Benzo(k)fluoranthene
_____	7.	Benzo(a)pyrene
_____	8.	Benzo(ghi)perylene
_____	9.	Butyl benzyl phthalate
_____	10.	Bis(2-chloroethyl)ether
_____	11.	Bis(2-chloroethoxy)methane
_____	12.	Bis(2-ethylhexyl)phthalate
_____	13.	Bis(2-chloroisopropyl)ether
_____	14.	4-Bromophenyl phenyl ether
_____	15.	2-Chloronaphthalene
_____	16.	4-Chlorophenyl phenyl ether
_____	17.	Chrysene
_____	18.	Dibenzo(a,h)anthracene
_____	19.	Di-n-butylphthalate
_____	20.	1,2-Dichlorobenzene
_____	21.	1,3-Dichlorobenzene
_____	22.	1,4-Dichlorobenzene
_____	23.	3,3'-Dichlorobenzidine
_____	24.	Diethyl phthalate
_____	25.	Dimethyl phthalate
_____	26.	2,4-Dinitrotoulene
_____	27.	2,6-Dinitrotoluene
_____	28.	Di-n-octylphthalate
_____	29.	Fluoranthene
_____	30.	Fluorene
_____	31.	Hexachlorobenzene
_____	32.	Hexachlorobutadiene
_____	33.	Hexachlorocyclopentadiene
_____	34.	Hexachloroethane
_____	35.	Indeno(1,2,3-c,d)pyrene
_____	36.	Isophorone
_____	37.	Naphthalene
_____	38.	Nitrobenzene
_____	39.	N-Nitrosodi-n-propylamine
_____	40.	Phenanthrene
_____	41.	Pyrene
_____	42.	1,2,4-Trichlorobenzene

EPA METHOD 625
ACID EXTRACTABLES
BY GC/MASS SPECTROPHOTOMETRY
MATRIX: WATER

_____	1.	4-Chloro-3-methylphenol
_____	2.	2-Chlorophenol
_____	3.	2,4-Dichlorophenol
_____	4.	2,4-Dimethylphenol
_____	5.	2,4-Dinitrophenol
_____	6.	2-Methyl-4,6-dinitrophenol
_____	7.	2-Nitrophenol
_____	8.	4-Nitrophenol
_____	9.	Pentachlorophenol
_____	10.	Phenol
_____	11.	2,4,6-Trichlorophenol

OTHER COMPOUNDS THAT CAN
BE DETERMINED

_____	1.	2,4,5-Trichlorophenol
_____	2.	2-Methylnaphthalene
_____	3.	2-Methylphenol
_____	4.	2-Nitroaniline
_____	5.	3-Nitroaniline
_____	6.	4-Chloroaniline
_____	7.	4-Methylphenol
_____	8.	4-Nitroaniline
_____	9.	Benzoic Acid
_____	10.	Benzyl alcohol
_____	11.	Dibenzofuran
_____	12.	enzidines (EPA 605 Compounds)
_____	13.	Nitrosamines (EPA 607 Compounds)
_____	14.	Organochlorine Pesticides and
_____	15.	PCBs (EPA 608 Compounds)

Instructions for Use:

1. If all compounds required leave boxes blank
2. If only certain compounds are required place an X in box next to compound
3. If certain compounds should be deleted from report cross out entire compound with heavy black felt tip pen

EPA METHOD SW-846 8010
HALOGENATED VOLATILE ORGANICS
BY GAS CHROMOTOGRAPHY
MATRIX: SOLID/SEMISOLID/WATER

_____	1.	Bromodichloromethane
_____	2.	Bromoform
_____	3.	Bromomethane
_____	4.	Carbon tetrachloride
_____	5.	Chlorobenzene
_____	6.	Chloroethane
_____	7.	2-Chloroethyl vinyl ether
_____	8.	Chloroform
_____	9.	Chloromethane
_____	10.	Dibromochloromethane
_____	11.	1,2-Dichlorobenzene
_____	12.	1,3-Dichlorobenzene
_____	13.	1,4-Dichlorobenzene
_____	14.	1,1-Dichloroethane
_____	15.	1,2-Dichloroethane
_____	16.	1,1-Dichloroethene
_____	17.	trans-1,2-Dichloroethene
_____	18.	1,2-Dichloropropane
_____	19.	cis-1,3-Dichloropropene
_____	20.	trans-1,3-Dichloropropene
_____	21.	Methylene chloride
_____	22.	1,1,1,2-Tetrachloroethane
_____	23.	1,1,2,2-Tetrachloroethane
_____	24.	Tetrachloroethene
_____	25.	1,1,1-Trichloroethane
_____	26.	1,1,2-Trichloroethane
_____	27.	Trichloroethene
_____	28.	Trichlorofluoromethane
_____	29.	Vinyl chloride

Instructions for Use:

1. If all compounds required leave boxes blank
2. If only certain compounds are required place an X in box next to compound
3. If certain compounds should be deleted from report cross out entire compound with heavy black felt tip pen

EPA METHOD SW-846 8010
HALOGENATED VOLATILE ORGANICS
BY GAS CHROMOTOGRAPHY
MATRIX: SOLID/SEMISOLID/WATER

OTHER COMPOUNDS THAT CAN
BE DETERMINED

_____1. Benzyl chloride
_____2. Bis(2-chloroethoxy)methane
_____3. Bromobenzene
_____4. 1-Chlorohexane
_____5. Chloromethylmethyl ether
_____6. Chlorotoluene
_____7. Dibromomethane
_____8. Dichlorodifluoromethane
_____9. Dichloromethane
_____10. Trichloropropane

Instructions for Use:

1. If all compounds required leave boxes blank
2. If only certain compounds are required place an X in box next to compound
3. If certain compounds should be deleted from report cross out entire compound with heavy black felt tip pen

EPA METHOD SW-846 8015
NONHALOGENATED VOLATILE ORGANICS
BY GAS CHROMOTOGRAPHY
MATRIX: SOIL/SEMISOLID/WATER

_____	1.	Acrylamide
_____	2.	Diethyl ether
_____	3.	Ethanol
_____	4.	Methyl ethyl ketone
_____	5.	Methyl isobutyl ketone
_____	6.	Paraldehyde

Instructions for Use:

1. If all compounds required leave boxes blank
2. If only certain compounds are required place an X in box next to compound
3. If certain compounds should be deleted from report cross out entire compound with heavy black felt tip pen

EPA METHOD SW-846 8020
AROMATIC VOLATILE ORGANICS
BY GAS CHROMOTOGRAPHY
MATRIX: SOIL/SEMISOLID/WATER

_____	1.	Benzene
_____	2.	Chlorobenzene
_____	3.	1,4-Dichlorobenzene
_____	4.	1,3-Dichlorobenzene
_____	5.	1,2-Dichlorobenzene
_____	6.	Ethyl benzene
_____	7.	Toluene
_____	8.	Xylenes

Instructions for Use:

1. If all compounds required leave boxes blank
2. If only certain compounds are required place an X in box next to compound
3. If certain compounds should be deleted from report cross out entire compound with heavy black felt tip pen

EPA METHOD SW-846 8021
VOLATILE ORGANICS
BY CAPILLARY COLUMN GC
MATRIX: SOIL/SEMISOLID/WATER

_____1. Benzene
_____2. Bromobenzene
_____3. Bromochloromethane
_____4. Bromodichloromethane
_____5. Bromoform
_____6. Bromomethane
_____7. n-Butylbenzene
_____8. sec-Butylbenzene
_____9. tert-Butylbenzene
_____10. Carbon tetrachloride
_____11. Chlorobenzene
_____12. Chloroethane
_____13. Chloroform
_____14. Chloromethane
_____15. 2-Chlorotoluene
_____16. 4-Chlorotoluene
_____17. Dibromochloromethane
_____18. 1,2-Dibromo-3-chloropropane
_____19. 1,2-Dibromomethane
_____20. Dibromomethane
_____21. 1,2-Dichlorobenzene
_____22. 1,3-Dichlorobenzene
_____23. 1,4-Dichlorobenzene
_____24. Dichlorodifluoromethane
_____25. 1,1-Dichloroethane
_____26. 1,2-Dichloroethane
_____27. 1,1-Dichloroethene
_____28. cis-1,2-Dichloroethene
_____29. trans-1,2-Dichloroethene
_____30. 1,2-Dichloropropane
_____31. 1,3-Dichloropropane
_____32. 2,2-Dichloropropane
_____33. 1,1-Dichloropropene
_____34. Ethylbenzene
_____35. Hexachlorobutadiene
_____36. Isopropylbenzene
_____37. p-Isopropyltoluene
_____38. Methylene chloride
_____39. Naphthalene
_____40. n-Propylbenzene
_____41. Styrene
_____42. 1,1,1,2-Tetrachloroethane
_____43. 1,1,2,2-Tetrachloroethane
_____44. Tetrachloroethene
_____45. Toluene
_____46. 1,2,3-Trichlorobenzene

EPA METHOD SW-846 8021
VOLATILE ORGANICS
BY CAPILLARY COLUMN GC
MATRIX: SOIL/SEMISOLID/ WATER

_____	47.	1,2,4-Trichlorobenzene
_____	48.	1,1,1-Trichloroethane
_____	49.	1,1,2-Trichloroethane
_____	50.	Trichloroethene
_____	48.	1,1,1-Trichloroethane
_____	49.	1,1,2-Trichloroethane
_____	50.	Trichloroethene
_____	51.	Trichlorofluoromethane
_____	52.	1,2,3-Trichloropropane
_____	53.	1,2,4-Trimethylbenzene
_____	54.	1,3,5-Trimethylbenzene
_____	55.	Vinyl chloride
_____	56.	o-Xylene
_____	57.	m-Xylene
_____	58.	p-Xylene

Instructions for Use:

1. If all compounds required leave boxes blank
2. If only certain compounds are required place an X in box next to compound
3. If certain compounds should be deleted from report cross out entire compound with heavy black felt tip pen

EPA METHOD SW-846 8030
ACROLEIN, ACRYLONITRILE, ACETONITRILE
BY GAS CHROMOTOGRAPHY
MATRIX: SOIL/SEMISOLID/WATER

_____	1.	Acetonitrile
_____	2.	Acrolein
_____	3.	Acrylonitrile

Instructions for Use:

1. If all compounds required leave boxes blank
2. If only certain compounds are required place an X in box next to compound
3. If certain compounds should be deleted from report cross out entire compound with heavy black felt tip pen

EPA METHOD SW-846 8040
PHENOLS
BY GAS CHROMOTOGRAPHY
MATRIX: SOIL/SEMISOLID/WATER

_____	1.	4-Chloro-3-methylphenol
_____	2.	2-Chlorophenol
_____	3.	2,4-Dichlorophenol
_____	4.	2,6-Dichlorophenol
_____	5.	2,4-Dimethylphenol
_____	6.	2,4-Dinitrophenol
_____	7.	2-Methyl-4,6-dinitrophenol
_____	8.	2-Nitrophenol
_____	9.	4-Nitrophenol
_____	10.	Pentachlorophenol
_____	11.	Phenol
_____	12.	2,4,6-Trichlorophenol

OTHER COMPOUNDS THAT CAN
BE DETERMINED

_____	1.	2-Sec-butyl-4,6-dinitrophenol
_____	2.	Cresols
_____	3.	2-Cyclohexyl-4,6-dinitrophenol
_____	4.	Tetrachlorophenols
_____	5.	Trichlorophenols

Instructions for Use:

1. If all compounds required leave boxes blank
2. If only certain compounds are required place an X in box next to compound
3. If certain compounds should be deleted from report cross out entire compound with heavy black felt tip pen

EPA METHOD SW-846 8060
PHTHALATE ESTERS
BY GAS CHROMOTOGRAPHY
MATRIX: SOIL/SEMISOLID/WATER

_____	1.	Butyl benzyl phthalate
_____	2.	Bis(2-ethylhexyl) phthalate
_____	3.	Diethyl phthalate
_____	4.	Dimethyl phthalate
_____	5.	Di-n-butyl phthalate
_____	6.	Di-n-octyl phthalate

Instructions for Use:

1. If all compounds required leave boxes blank
2. If only certain compounds are required place an X in box next to compound
3. If certain compounds should be deleted from report cross out entire compound with heavy black felt tip pen

EPA METHOD SW-846 8070
NITROSAMINES
BY GAS CHROMOTOGRAPHY
MATRIX: SOIL/SEMISOLID/WATER

_____	1.	N-Nitrosodimethylamine
_____	2.	N-Nitrosodiphenylamine
_____	3.	N-Nitrosodi-n-propylamine

Instructions for Use:

1. If all compounds required leave boxes blank
2. If only certain compounds are required place an X in box next to compound
3. If certain compounds should be deleted from report cross out entire compound with heavy black felt tip pen

EPA METHOD SW-846 8080
ORGANOCHLORINE PESTICIDES AND PCBs
BY GAS CHROMOTOGRAPHY
MATRIX: SOIL/SEMISOLID/WATER

_____	1.	Aldrin
_____	2.	alpha-BHC
_____	3.	beta-BHC
_____	4.	delta-BHC
_____	5.	gamma-BHC (lindane)
_____	6.	Chlordane
_____	7.	4,4'-DDD
_____	8.	4,4'-DDE
_____	9.	4,4'-DDT
_____	10.	Dieldrin
_____	11.	Endosulfan I
_____	12.	Endosulfan II
_____	13.	Endosulfan sulfate
_____	14.	Endrin
_____	15.	Endrin aldehyde
_____	16.	Heptachlor
_____	17.	Heptachlor epoxide
_____	18.	Methoxychlor
_____	19.	Toxaphene
_____	20.	PCB-1016
_____	21.	PCB-1221
_____	22.	PCB-1232
_____	23.	PCB-1242
_____	24.	PCB-1248
_____	25.	PCB-1254
_____	26.	PCB-1260

Instructions for Use:

1. If all compounds required leave boxes blank
2. If only certain compounds are required place an X in box next to compound
3. If certain compounds should be deleted from report cross out entire compound with heavy black felt tip pen

EPA METHOD SW-846 8090
NITROAROMATICS AND CYCLIC KETONES
BY GAS CHROMOTOGRAPHY
MATRIX: SOIL/SEMISOLID/WATER

_____	1.	2,4-Dinitrotoluene
_____	2.	2,6-Dinitrotoluene
_____	3.	Dinitrobenzene
_____	4.	Isophorone
_____	5.	Napthoquinone
_____	6.	Nitrobenzene

Instructions for Use:

1. If all compounds required leave boxes blank
2. If only certain compounds are required place an X in box next to compound
3. If certain compounds should be deleted from report cross out entire compound with heavy black felt tip pen

EPA METHOD SW-846 8100
POLYNUCLEAR AROMATIC HYDROCARBONS
BY GAS CHROMOTOGRAPHY
MATRIX: SOIL/SEMISOLID/WATER

_____	1.	Acanapthene
_____	2.	Acenaphthylene
_____	3.	Anathracene
_____	4.	Benzo(a)anthracene
_____	5.	Benzo(a)pyrene
_____	6.	Benzo(b)fluoranthene
_____	7.	Benzo(j)fluoranthene
_____	8.	Benzo(k)fluoranthene
_____	9.	Benzo(g,h,i)perylene
_____	10.	Chrysene
_____	11.	Dibenz(a,h)acridine
_____	12.	Dibenz(a,j)acridine
_____	13.	Dibenzo(a,h)anthracene
_____	14.	7H-Dibenzo(c,g)carbozole
_____	15.	Dibenzo(a,e)pyrene
_____	16.	Dibenzo(a,h)pyrene
_____	17.	Dibenzo(a,i)pyrene
_____	18.	Fluoranthene
_____	19.	Fluorene
_____	20.	Indeno(1,2,3-cd)pyrene
_____	21.	3-Methylcholanthrene
_____	22.	Naphthalene
_____	23.	Phenanthrene
_____	24.	Pyrene

Instructions for Use:

1. If all compounds required leave boxes blank
2. If only certain compounds are required place an X in box next to compound
3. If certain compounds should be deleted from report cross out entire compound with heavy black felt tip pen

EPA METHOD SW-846 8110
HALOETHERS
BY GAS CHROMOTOGRAPHY
MATRIX: SOIL/SEMISOLID/WATER

_____	1.	Bis(2-chloroethoxy) methane
_____	2.	Bis(2-chloroethyl) ether
_____	3.	Bis(2-chloroisopropyl) ether
_____	4.	4-Bromophenyl phenyl ether
_____	5.	4-Chlorophenyl phenyl ether

Instructions for Use:

1. If all compounds required leave boxes blank
2. If only certain compounds are required place an X in box next to compound
3. If certain compounds should be deleted from report cross out entire compound with heavy black felt tip pen

EPA METHOD SW-846 8120
CHLORINATED HYDROCARBONS
BY GAS CHROMOTOGRAPHY
MATRIX: SOIL/SEMISOLID/WATER

_____	1.	1,2,4-Trichlorobenzene
_____	2.	1,2-Dichlorobenzene
_____	3.	1,3-Dichlorobenzene
_____	4.	1,4-Dichlorobenzene
_____	5.	2-Chloronaphthalene
_____	6.	Hexachlorobenzene
_____	7.	Hexachlorobutadiene
_____	8.	Hexachlorocyclohexane
_____	9.	Hexachlorocyclopentadiene
_____	10.	Hexachloroethane
_____	11.	Pentachlorohexane
_____	12.	Tetrachlorobenzenes

OTHER COMPOUNDS THAT CAN
BE DETERMINED

_____	1.	Benzal chloride
_____	2.	Benzotrichloride
_____	3.	Benzyl chloride

Instructions for Use:

1. If all compounds required leave boxes blank
2. If only certain compounds are required place an X in box next to compound
3. If certain compounds should be deleted from report cross out entire compound with heavy black felt tip pen

EPA METHOD SW-846 8140/8141
ORGANOPHOSPHORUS PESTICIDES
BY GAS CHROMOTOGRAPHY
MATRIX: SOIL/SEMISOLID/WATER

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_____1. Azinphos methyl
_____2. Bolstar
_____3. Chlorpyrifos
_____4. Coumaphos
_____5. Demeton-O
_____6. Demeton-S
_____7. Diazinon
_____8. Dichlorvos
_____9. Disulfoton
_____10. EPN Phosphamidion
_____11. Ethoprop
_____12. Fensulfothion
_____13. Fenthion
_____14. Malathion
_____15. Merphos
_____16. Mevinphos
_____17. Monocrotophos
_____18. Naled
_____19. Parathion-ethyl
_____20. Parathion-methyl
_____21. Phorate
_____22. Ronnel
_____23. Sulfotep
_____24. TEPP
_____25. Stirophos
_____26. Tokuthian
_____27. Trichloronate

==========

Instructions for Use:

1. If all compounds required leave boxes blank

2. If only certain compounds are required place an X in box next to compound

3. If certain compounds should be deleted from report cross out entire compound with heavy black felt tip pen

EPA METHOD SW-846 8140/8141
ORGANOPHOSPHORUS PESTICIDES
BY GAS CHROMOTOGRAPHY
MATRIX: SOIL/SEMISOLID/WATER

OTHER COMPOUNDS THAT CAN
BE DETERMINED

_____1. Azinphos ethyl
_____2. Carbofenthion
_____3. Chlorfenvinphos
_____4. Dioxathion
_____5. Ethion
_____6. Famphur
_____7. HMPA
_____8. Leptophos
_____9. Phosmet
_____10. Phosphamidion
_____11. Terbuphos
_____12. TOCP

Instructions for Use:

1. If all compounds required leave boxes blank
2. If only certain compounds are required place an X in box next to compound
3. If certain compounds should be deleted from report cross out entire compound with heavy black felt tip pen

EPA METHOD SW-846 8150
CHLORINATED HERBICIDES
BY GAS CHROMOTOGRAPHY
MATRIX: SOIL/SEMISOLID/WATER

_____	1.	2,4-D
_____	2.	2,4-DB
_____	3.	2,4,5-T
_____	4.	2,4,5-TP (Silvex)
_____	5.	Dalapon
_____	6.	Dicamba
_____	7.	Dichloroprop
_____	8.	Dinoseb
_____	9.	MCPA
_____	10.	MCPP

Instructions for Use:

1. If all compounds required leave boxes blank
2. If only certain compounds are required place an X in box next to compound
3. If certain compounds should be deleted from report cross out entire compound with heavy black felt tip pen

EPA METHOD SW-846 8240
VOLATILE ORGANICS
BY PACKED COLUMN GC/MS
MATRIX: SOIL/SEMISOLID/WATER

_____1. Acetone
_____2. Acetonitrile
_____3. Allyl chloride
_____4. Benzene
_____5. Benzyl chloride
_____6. Bromodichloromethane
_____7. Bromoform
_____8. Bromomethane
_____9. 2-Butanone
_____10. Carbon disulfide
_____11. Carbon tetrachloride
_____12. Chlorobenzene
_____13. Chlorodibromomethane
_____14. Chloroethane
_____15. 2-Chloroethyl vinyl ether
_____16. Chloroform
_____17. Chloromethane
_____18. Chloroprene
_____19. 1,2-Dibromo-3-chloropropane
_____20. 1,2-Dibromoethane
_____21. Dibromomethane
_____22. 1,4-Dichloro-2-butene
_____23. Dichlorodifluoromethane
_____24. 1,1-Dichloroethane
_____25. 1,2-Dichloroethane
_____26. 1,1-Dichloroethene
_____27. trans-1,2-Dichloroethene
_____28. 1,2-Dichloropropane
_____29. cis-1,3-Dichloropropene
_____30. trans-1,3-Dichloropropene
_____31. Ethylbenzene
_____32. Ethyl methacrylate
_____33. 2-Hexanone
_____34. Isobutyl alcohol
_____35. Methacrylonitrile
_____36. Methylene chloride
_____37. Methyl iodide
_____38. Methyl methacrylate
_____39. 4-Methyl-2-pentanone
_____40. Pentachloroethane
_____41. Propionitrile
_____42. Styrene
_____43. 1,1,1,2-Tetrachloroethane
_____44. 1,1,2,2-Tetrachloroethane
_____45. Tetrachloroethene
_____46. Toluene
_____47. 1,1,1-Trichloroethane

EPA METHOD SW-846 8240
VOLATILE ORGANICS
BY PACKED COLUMN GS/MS
MATRIX: SOIL/SEMISOLID/WATER

_____	48.	1,1,2-Trichloroethane
_____	49.	Trichloroethene
_____	50.	1,2,3-Trichloropropane
_____	51.	Vinyl acetate
_____	52.	Vinyl chloride
_____	53.	Xylene (total)

OTHER COMPOUNDS THAT CAN BE DETERMINED

_____	1.	Acrolein
_____	2.	Acrylonitrile
_____	3.	Allyl alcohol
_____	4.	Bromoacetone
_____	5.	2-Chloroethanol
_____	6.	3-Chloropropionitrile
_____	7.	1,3-Dichloro-2-propanol
_____	8.	1,2:3,4-Diepoxybutane
_____	9.	1,4-Dioxane
_____	10.	Epichlorohydrin
_____	11.	Ethanol
_____	12.	Ethylene oxide
_____	13.	2-Hydroxypropionitrile
_____	14.	Iodomethane
_____	15.	Malononitrile
_____	16.	2-Picoline
_____	17.	Propargyl alcohol
_____	18.	b-Propiolactone
_____	19.	n-Propylamine
_____	20.	Pyridine
_____	21.	Trichlorofluoromethane

Instructions for Use:

1. If all compounds required leave boxes blank
2. If only certain compounds are required place an X in box next to compound
3. If certain compounds should be deleted from report cross out entire compound with heavy black felt tip pen

EPA METHOD SW-846 8250
BASE/NEUTRAL ACID EXTRACTABLES
BY PACKED COLUMN GC/MS
MATRIX: SOIL/SEMISOLID/WATER

_____1. Acenaphthene
_____2. Acenaphthylene
_____3. Aldrin
_____4. Anthracene
_____5. Benzo(a)anthracene
_____6. Benzo(b)fluoranthene
_____7. Benzo(k)fluoranthene
_____8. Benzo(a)pyrene
_____9. Benzo(ghi)perylene
_____10. Butyl benzyl phthalate
_____11. beta-BHC
_____12. delta-BHC
_____13. Bis(2-chloroethyl)ether
_____14. Bis(2-chloroethoxy)methane
_____15. Bis(2-chloroisopropyl)ether
_____16. Bis(2-ethylhexyl)phthalate
_____17. 4-Bromophenyl phenyl ether
_____18. 2-Chloronaphthalene
_____19. 4-Chlorophenyl phenyl ether
_____20. Chrysene
_____21. 4,4'-DDD
_____22. 4,4'-DDE
_____23. 4,4'-DDT
_____24. Dibenz(a,h)anthracene
_____25. Di-n-butyl phthalate
_____26. 1,2-Dichlorobenzene
_____27. 1,3-Dichlorobenzene
_____28. 1,4-Dichlorobenzene
_____29. 3,3'-Dichlorobenzidine
_____30. Dieldrin
_____31. Diethyl phthalate
_____32. Dimethyl phthalate
_____33. 2,4-Dinitrotoulene
_____34. 2,6-Dinitrotoluene
_____35. Di-n-octylphthalate
_____36. Endosulfan sulfate
_____37. Endrin aldehyde
_____38. Fluoranthene
_____39. Fluorene
_____40. Heptachlor
_____41. Heptachlor epoxide
_____42. Hexachlorobenzene
_____43. Hexachlorobutadiene
_____44. Hexachloroethane
_____45. Indeno(1,2,3-c,d)pyrene
_____46. Isophorone
_____47. Naphthalene

EPA METHOD SW-846 8250
BASE/NEUTRAL ACID EXTRACTABLES
BY PACKED COLUMN GC/MS
MATRIX: SOIL/SEMISOLID/WATER

_____	48.	Nitrobenzene
_____	49.	N-Nitroso-di-n-propylamine
_____	50.	Aroclor-1260
_____	51.	Phenanthrene
_____	52.	Pyrene
_____	53.	1,2,4-Trichlorobenzene
_____	54.	4-Chloro-3-methylphenol
_____	55.	2-Chlorophenol
_____	56.	2,4-Dichlorophenol
_____	57.	2,4-Dimethylphenol
_____	58.	2,4-Dinitrophenol
_____	59.	2-Methyl-4,6-Dinitrophenol
_____	60.	2-Nitrophenol
_____	61.	4-Nitrophenol
_____	62.	Pentachlorophenol
_____	63.	Phenol
_____	64.	2,4,6-Trichlorophenol

Instructions for Use:

1. If all compounds required leave boxes blank
2. If only certain compounds are required place an X in box next to compound
3. If certain compounds should be deleted from report cross out entire compound with heavy black felt tip pen

EPA METHOD SW-846 8250
BASE/NEUTRAL ACID EXTRACTABLES
BY PACKED COLUMN GC/MS
MATRIX: SOIL/SEMISOLID/WATER

OTHER COMPOUNDS THAT CAN
BE DETERMINED

_____1. 1,2,4,5-Tetrachlorobenzene
_____2. 1,2-Diphenylhydrazine
_____3. 1-Chloronaphthalene
_____4. 1-Naphthylamine
_____5. 2,3,4,6-Tetrachlorophenol
_____6. 2,4,5-Trichlorophenol
_____7. 2,6-Dichlorophenol
_____8. 2-Methylnaphthalene
_____9. 2-Methylphenol
_____10. 2-Naphthylamine
_____11. 2-Nitroaniline
_____12. 2-Picoline
_____13. 3-Methylcholanthrene
_____14. 3-Nitroaniline
_____15. 4,4'-DDT
_____16. 4-Aminobiphenyl
_____17. 4-Chloroaniline
_____18. 4-Methylphenol
_____19. 4-Nitroaniline
_____20. 7,12-Dimethylbenz(a)anthracene
_____21. Acetophenone
_____22. alpha,alpha-Dimethylphenethylamine
_____23. alpha-BHC
_____24. Aniline
_____25. Aroclor-1016
_____26. Aroclor-1221
_____27. Aroclor-1232
_____28. Aroclor-1242
_____29. Aroclor-1248
_____30. Aroclor-1254
_____31. Benzidine
_____32. Benzoic acid
_____33. Benzyl alcohol
_____34. Chlordane
_____35. Dibenzofuran
_____36. Dibenz(a,j)acridine
_____37. Diphenylamine
_____38. Endosulfan I
_____39. Endosulfan II
_____40. Endrin

EPA METHOD SW-846 8250
BASE/NEUTRAL ACID EXTRACTABLES
BY PACKED COLUMN GC/MS
MATRIX: SOIL/SEMISOLID/WATER

OTHER COMPOUNDS THAT CAN
BE DETERMINED

_____41. Endrin ketone
_____42. Ethyl methanesulfonate
_____43. gamma-BHC (lindane)
_____44. Hexachlorocyclopentadiene
_____45. Methoxychlor
_____46. Methyl methanesulfonate
_____47. N-Nitrosodimethylamine
_____48. N-Nitrosodiphenylamine
_____49. N-Nitrosopiperidine
_____50. N-Nitroso-di-n-butylamine
_____51. Pentachlorobenzene
_____52. Pentachloronitrobenzene
_____53. Phenacetin
_____54. Pronamide
_____55. p-Dimethylaminoazobenzene
_____56. Toxaphene

Instructions for Use:

1. If all compounds required leave boxes blank
2. If only certain compounds are required place an X in box next to compound
3. If certain compounds should be deleted from report cross out entire compound with heavy black felt tip pen

EPA METHOD SW-846 8260
VOLATILE ORGANICS
BY CAPILLARY COLUMN GC
MATRIX: SOLID/SEMISOLID/WATER

_____	1.	Benzene
_____	2.	Bromobenzene
_____	3.	Bromochloromethane
_____	4.	Bromodichloromethane
_____	5.	Bromoform
_____	6.	Bromomethane
_____	7.	n-Butylbenzene
_____	8.	sec-Butylbenzene
_____	9.	tert-Butylbenzene
_____	10.	Carbon tetrachloride
_____	11.	Chlorobenzene
_____	12.	Chloroethane
_____	13.	Chloroform
_____	14.	Chloromethane
_____	15.	2-Chlorotoluene
_____	16.	4-Chlorotoluene
_____	17.	Dibromochloromethane
_____	18.	1,2-Dibromo-3-chloropropane
_____	19.	1,2-Dibromoethane
_____	20.	Dibromomethane
_____	21.	1,2-Dichlorobenzene
_____	22.	1,3-Dichlorobenzene
_____	23.	1,4-Dichlorobenzene
_____	24.	Dichlorodifluoromethane
_____	25.	1,1-Dichloroethane
_____	26.	1,2-Dichloroethane
_____	27.	1,1-Dichloroethene
_____	28.	cis-1,2-Dichloroethene
_____	29.	trans-1,2-Dichloroethene
_____	30.	1,2-Dichloropropane
_____	31.	1,3-Dichloropropane
_____	32.	2,2-Dichloropropane
_____	33.	1,1-Dichloropropene
_____	34.	Ethylbenzene
_____	35.	Hexachlorobutadiene
_____	36.	Isopropylbenzene
_____	37.	p-Isopropyltoluene
_____	38.	Methylene chloride
_____	39.	Naphthalene
_____	40.	n-Propylbenzene
_____	41.	Styrene
_____	42.	1,1,1,2-Tetrachloroethane
_____	43.	1,1,2,2-Tetrachloroethane
_____	44.	Tetrachloroethene
_____	45.	Toluene
_____	46.	1,2,3-Trichlorobenzene
_____	47.	1,2,4-Trichlorobenzene

EPA METHOD SW-846 8260
VOLATILE ORGANICS
BY CAPILLARY COLUMN GC
MATRIX: SOLID/SEMISOLID/WATER

_____48. 1,1,1-Trichloroethane
_____49. 1,1,2-Trichloroethane
_____50. Trichloroethene
_____51. Trichlorofluoromethane
_____52. 1,2,3-Trichloropropane
_____53. 1,2,4-Trimethylbenzene
_____54. 1,3,5-Trimethylbenzene
_____55. Vinyl chloride
_____56. o-Xylene
_____57. m-Xylene
_____58. p-Xylene

OTHER COMPOUNDS THAT CAN
BE DETERMINED

_____1. 1-Chlorohexane

Instructions for Use:

1. If all compounds required leave boxes blank
2. If only certain compounds are required place an X in box next to compound
3. If certain compounds should be deleted from report cross out entire compound with heavy black felt tip pen

EPA METHOD SW-846 8270
BASE/NEUTRAL AND ACID EXTRACTABLES
BY CAPILLARY COLUMN GC/MS
MATRIX: SOLID/SEMISOLID/WATER

_____	1.	Acenapthene
_____	2.	Acenaphthylene
_____	3.	Acetophenone
_____	4.	2-Acetylaminofluorene
_____	5.	1-Acetyl-2-thiourea
_____	6.	2-Aminoanthraquinone
_____	7.	Aminoazobenzene
_____	8.	4-Aminobiphenyl
_____	9.	Anilazine
_____	10.	o-Anisidine
_____	11.	Anthracene
_____	12.	Aramite
_____	13.	Azinphos-methyl
_____	14.	Barban
_____	15.	Benzo(a)anthracene
_____	16.	Benzo(b)fluoranthene
_____	17.	Benzo(k)fluoranthene
_____	18.	Benzoic acid
_____	19.	Benzo(g,h,i)perylene
_____	20.	Benzo(a)pyrene
_____	21.	p-Benzoquinone
_____	22.	Benzyl alcohol
_____	23.	Bis(2-chloroethoxy) methane
_____	24.	Bis(2-chloroethyl) ether
_____	25.	Bis(2-chloroisopropyl) ether
_____	26.	4-Bromophenyl phenyl ether
_____	27.	Bromoxynil
_____	28.	Butyl benzyl phthalate
_____	29.	Captafol
_____	30.	Captan
_____	31.	Carbaryl
_____	32.	Carbofuran
_____	33.	Carbophenothion
_____	34.	Chlorfenvinphos
_____	35.	4-Chloroaniline
_____	36.	Chlorobenzilate
_____	37.	5-Chloro-2-methylaniline
_____	38.	4-Chloro-3-methylphenol
_____	39.	3-(Chloromethyl) pyridine hydrochloride
_____	40.	2-Chloronaphthalene
_____	41.	2-Chlorophenol
_____	42.	4-Chlorophenyl phenyl ether
_____	43.	Chrysene
_____	44.	Coumaphos
_____	45.	p-Cresidine
_____	46.	Crotoxyphos
_____	47.	2-Cyclohexyl-4,6-dinitrophenol

_____48. Demeton-o
_____49. Demeton-s
_____50. cis-Diallate
_____51. trans-Diallate
_____52. 2,4-Diaminotoluene
_____53. Dibenz(a,j)acridine
_____54. Dibenz(a,h)anthracene
_____55. Dibenzofuran
_____56. Dibenzo(a,e)pyrene
_____57. Di-n-butylphthalate
_____58. Dichlone
_____59. 1,2-Dichlorobenzene
_____60. 1,3-Dichlorobenzene
_____61. 1,4-Dichlorobenzene
_____62. 3,3'-Dichlorobenzidine
_____63. 2,4-Dichlorophenol
_____64. 2,6-Dichlorophenol
_____65. Dichlorovos
_____66. Dicrotophos
_____67. Diethyphthalate
_____68. Diethylstilbesterol
_____69. Diethyl sulfate
_____70. Dimethoate
_____71. 3,3'-Dimethoxybenzidine
_____72. Dimethylaminoazobenzene
_____73. 7,12-Dimethylbenz(a)anthracene
_____74. 3,3'-Dimethylbenzidine
_____75. a,a-Dimethylphenethylamine
_____76. 2,4-Dimethylphenol
_____77. Dimethyl phthalate
_____78. 1,2-Dinitrobenzene
_____79. 1,3-Dinitrobenzene
_____80. 1,4-Dinitrobenzene
_____81. 4,6-Dinitro-2-methylphenol
_____82. 2,4-Dinitrophenol
_____83. 2,4-Dinitrotoluene
_____84. 2,6-Dinitrotoluene
_____85. Dinocap
_____86. Dinoseb
_____87. 5,5-Diphenylhydantoin
_____88. Di-n-octyl phthalate
_____89. Disulfoton
_____90. EPN
_____91. Ethion
_____92. Ethyl cabamate
_____93. Bis(2-ethylhexyl)phthalate
_____94. Ethyl methanesulfonate

_____95. Famphur
_____96. Fensulfothion
_____97. Fenthion
_____98. Fluchloralin
_____99. Fluoranthene
_____100. Fluorene
_____101. Hexachlorobenzene
_____102. Hexachlorobutadiene
_____103. Hexachloeocyclopentadiene
_____104. Cexachloroethane
_____105. Hexachloeophene
_____106. Hexachloeopropene
_____107. Hexamethyl phosphoramide
_____108. Hydroquinone
_____109. Indeno(1,2,3-cd)pyrene
_____110. Isodrin
_____111. Isophorone
_____112. Isosafrole
_____113. Kepone
_____114. Leptophos
_____115. Malathion
_____116. Maleic anhydride
_____117. Mestranol
_____118. Methapyrilene 119. Methoxychlor
_____120. 3-Methylcholanthrene
_____121. 4,4'-Methylenebis(2-chloroaniline)
_____122. Methylmethanesulfonate
_____123. 2-Methylnaphthalene
_____124. Methyl parathion
_____125. 2-Methylphenol
_____126. 3-Methylphenol
_____127. 4-Methylphenol
_____128. Mevinphos
_____129. Mexacarbate
_____130. Mirex
_____131. Monocrotophos
_____132. Naled
_____133. Naphthalene
_____134. 1,4-Naphthoquinone
_____135. 1-Naphthylamine
_____136. 2-Naphthylamine
_____137. Nicotine
_____138. 5-Nitroacenaphthene
_____139. 2-Nitroaniline
_____140. 3-Nitroaniline
_____141. 4-Nitroaniline
_____142. 5-Nitro-o-anisidine

_____143. Nitrobenzene
_____144. 4-Nitrobiphenyl
_____145. Nitrofen
_____146. 2-Nitrophenol
_____147. 4-Nitrophenol
_____148. 5-Nitro-o-toluidine
_____149. 4-Nitroquinoline-1-oxide
_____150. N-Nitrosodibutylamine
_____151. N-Nitrosodiethylamine
_____152. N-Nitrosodiphenylamine
_____153. N-Nitroso-di-n-propylamine
_____154. N-Nitrosopiperidine
_____155. N-Nitrosopyrrolidine
_____156. Octamethyl pyrophosporamide
_____157. 4,4'-Oxydianiline
_____158. Parathion
_____159. Pentachlorobenzene
_____160. Pentachloronitrobenzene
_____161. Pentachlorophenol
_____162. Phenacetin
_____163. Phenanthrene
_____164. Phenobarbital
_____165. Phenol
_____166. 1,4-Phenylenediamine
_____167. Phorate
_____168. Phosalone
_____169. Phosmet
_____170. Phosphamidon
_____171. Phthalic anhydride
_____172. 2-Picoline
_____173. Piperonyl sulfoxide
_____174. Pronamide
_____175. Propylthiouracil
_____176. Pyrene
_____177. Pyridine
_____178. Resorcinol
_____179. Safrole
_____180. Strychnine
_____181. Sulfallate
_____182. Terbufos
_____183. 1,2,4,5-Tetrachlorobenzene
_____184. 2,3,4,6-Tetrachlorophenol
_____185. Tetrachlorvinphos
_____186. Tetraethyl pyrophosphate
_____187. Thionazine
_____188. Thiophenol
_____189. Toluene diisocyanate

EPA METHOD SW-846 8270
BASE/NEUTRAL AND ACID EXTRACTABLES
BY CAPILLARY COLUMN GC/MS
MATRIX: SOLID/SEMISOLID/WATER

_____	190.	o-Toluidine
_____	191.	1,2,4-Trichlorbenzene
_____	192.	2,4,5-Trichlorophenol
_____	193.	2,4,6-Trichlorophenol
_____	194.	Trifluralin
_____	195.	2,4,5-Trimethylaniline
_____	196.	Trimethyl phosphate
_____	197.	1,3,5-Trinitrobenzene
_____	198.	Tris(2,3-dibromopropyl) phosphate
_____	199.	Tri-p-tolyl phosphate
_____	200.	0,0,0-Triethylphosphorthioate

Instructions for Use:

1. If all compounds required leave boxes blank
2. If only certain compounds are required place an X in box next to compound
3. If certain compounds should be deleted from report cross out entire compound with heavy black felt tip pen

POLYCHLORINATED DIBENZO-P-DIOXINS AND
POLYCHLORINATED DIBENZOFURANS
METHOD: SW-846 8280

_____	1.	2,3,7,8-TCDD
_____	2.	1,2,3,4-TCDD
_____	3.	1,3,6,8-TCDD
_____	4.	1,3,7,9-TCDD
_____	5.	1,3,7,8-TCDD
_____	6.	1,2,7,8-TCDD
_____	7.	1,2,8,9-TCDD
_____	8.	1,2,3,4,7-PeCDD
_____	9.	1,2,3,7,8-PeCDD
_____	10.	1,2,3,4,7,8-HxCDD
_____	11.	1,2,3,4,6,7,8-HpCDD
_____	12.	1,2,7,8-TCDF
_____	13.	1,2,3,7,8-PeCDF
_____	14.	1,2,3,4,7,8-HxCDF
_____	15.	OCDF

Instructions for Use:

1. If all compounds required leave boxes blank
2. If only certain compounds are required place an X in box next to compound
3. If certain compounds should be deleted from report cross out entire compound with heavy black felt tip pen

EPA METHOD SW-846 8310
POLYNUCLEAR AROMATIC HYDROCARBONS
BY HIGH PERFORMANCE LIQUID CHROMOTOGRAPHY
MATRIX: SOIL/SEMISOLID/WATER

_____	1.	Acenaphthene
_____	2.	Acenaphthylene
_____	3.	Anathracene
_____	4.	Benzo(a)anthracene
_____	5.	Benzo(a)pyrene
_____	6.	Benzo(b)fluoranthene
_____	7.	Benzo(ghi)perylene
_____	8.	Benzo(k)fluoranthene
_____	9.	Chrysene
_____	10.	Dibenzo(a,h)anthracene
_____	11.	Fluoranthene
_____	12.	Fluorene
_____	13.	Indeno(1,2,3-cd)pyrene
_____	14.	Naphthalene
_____	15.	Phenanthrene
_____	16.	Pyrene

Instructions for Use:

1. If all compounds required leave boxes blank
2. If only certain compounds are required place an X in box next to compound
3. If certain compounds should be deleted from report cross out entire compound with heavy black felt tip pen

SECTION 5.0

STANDARDIZED ANALYTE LISTS BY REGULATORY COMPOUND GROUPINGS

Primary Drinking Water Metals
Priority Pollutant
Hazardous Substance List (HSL)
Target Compound List (TCL-CLP)
Appendix IX

TARGET ANALYTE LIST
METALS (TCL/HSL/SUPERFUND)
EPA METHODS VARIOUS
MATRIX: WATER/SOIL/SEMISOLID

==========

_____1. Aluminum
_____2. Antimony
_____3. Arsenic
_____4. Barium
_____5. Beryllium
_____6. Cadmium
_____7. Calcium
_____8. Chromium
_____9. Cobalt
_____10. Copper
_____11. Iron
_____12. Lead
_____13. Magnesium
_____14. Manganese
_____15. Mercury
_____16. Nickel
_____17. Potassium
_____18. Selenium
_____19. Silver
_____20. Sodium
_____21. Thallium
_____22. Vanadium
_____23. Zinc
_____24. Cyanide

==========

Instructions for Use:

1. If all compounds required leave boxes blank

2. If only certain compounds are required place an X in box next to compound

3. If certain compounds should be deleted from report cross out entire compound with heavy black felt tip pen

TARGET COMPOUND LIST (TCL/HSL/SUPERFUND)
PESTICIDES AND PCBs
EPA METHODS 608-CLP-M/608/8080
BY GAS CHROMOTOGRAPHY
MATRIX: WATER/SOIL/SEMISOLID

==========

_____1. 4,4'-DDD
_____2. 4,4'-DDE
_____3. 4,4'-DDT
_____4. Aldrin
_____5. alpha-BHC
_____6. beta-BHC
_____7. alpha-Chlordane
_____8. gamma-Chlordane
_____9. Dieldrin
_____10. delta-BHC
_____11. Endosulfan I
_____12. Endosulfan II
_____13. Endosulfan sulfate
_____14. Endrin
_____15. Endrin ketone
_____16. gamma-BHC (Lindane)
_____17. Heptachlor
_____18. Heptachlor epoxide
_____19. Methoxychlor
_____20. PCB-1016
_____21. PCB-1221
_____22. PCB-1232
_____23. PCB-1242
_____24. PCB-1248
_____25. PCB-1254
_____26. PCB-1260
_____27. Toxaphene

==========

Instructions for Use:

1. If all compounds required leave boxes blank

2. If only certain compounds are required place an X in box next to compound

3. If certain compounds should be deleted from report cross out entire compound with heavy black felt tip pen

TARGET COMPOUND LIST (TCL/HSL/SUPERFUND)
VOLATILE ORGANIC COMPOUNDS
EPA METHODS 624-CLP-M/624/8240/8260
MATRIX: WATER/SOIL/SEMISOLID

_____	1.	1,1,1-Trichloroethane
_____	2.	1,1,2,2-Tetrachloroethane
_____	3.	1,1,2-Trichloroethane
_____	4.	1,1-Dichloroethane
_____	5.	1,1-Dichloroethene
_____	6.	1,2-Dichloroethane
_____	7.	1,2-Dichloroethene (total)
_____	8.	1,2-Dichloropropane
_____	9.	2-Butanone
_____	10.	2-Hexanone
_____	11.	4-Methyl-2-pentanone
_____	12.	Acetone
_____	13.	Benzene
_____	14.	Bromodichloromethane
_____	15.	Bromoform
_____	16.	Bromomethane
_____	17.	Carbon Disulfide
_____	18.	Carbon tetrachloride
_____	19.	Chlorobenzene
_____	20.	Chloroethane
_____	21.	Chloroform
_____	22.	Chloromethane
_____	23.	cis-1,3-Dichloropropene
_____	24.	Dibromochloromethane
_____	25.	Ethyl Benzene
_____	26.	Methylene chloride
_____	27.	Styrene
_____	28.	Tetrachloroethene
_____	29.	Toluene
_____	30.	trans-1,3-Dichloropropene
_____	31.	Trichloroethene
_____	32.	Vinyl chloride
_____	33.	Xylenes (total)

Instructions for Use:

1. If all compounds required leave boxes blank
2. If only certain compounds are required place an X in box next to compound
3. If certain compounds should be deleted from report cross out entire compound with heavy black felt tip pen

TARGET COMPOUND LIST (TCL/HSL/SUPERFUND)
BASE/NEUTRAL EXTRACTABLES
EPA METHODS 625-CLP-M/625/8250/8270
BY GC/MASS SPECTROPHOTOMETRY
MATRIX: WATER/SOIL/SEMISOLID

_____1. 1,2,4-Trichlorobenzene
_____2. 1,2-Dichlorobenzene
_____3. 1,3-Dichlorobenzene
_____4. 1,4-Dichlorobenzene
_____5. 2,4-Dinitrotoluene
_____6. 2,6-Dinitrotoluene
_____7. 2-Chloronaphthalene
_____8. 2-Methylnaphthalene
_____9. 2-Nitroaniline
_____10. 3,3'-Dichlorobenzidine
_____11. 3-Nitroaniline
_____12. 4-Bromophenyl-phenylether
_____13. 4-Chloroaniline
_____14. 4-Chlorophenyl phenyl ether
_____15. 4-Nitroaniline
_____16. Acenaphthylene
_____17. Acenapthene
_____18. Anthracene
_____19. Benzo(a)anthracene
_____20. Benzo(a)pyrene
_____21. Benzo(b)fluoranthene
_____22. Benzo(g,h,i)perylene
_____23. Benzo(k)fluoranthene
_____24. Benzyl alcohol
_____25. bis(2-Chloroethoxy) methane
_____26. bis(2-Chloroethyl) ether
_____27. bis(2-Chloroisopropyl) ether
_____28. bis(2-Ethylhexyl)phthalate
_____29. Butylbenzylphthalate
_____30. Carbazole
_____31. Chrysene
_____32. Dibenzofuran
_____33. Dibenz(a,h)anthracene
_____34. Diethylphthalate
_____35. Dimethylphthalate
_____36. Di-n-butylphthalate
_____37. Di-n-octylphthalate
_____38. Fluoranthene
_____39. Fluorene
_____40. Hexachlorobenzene
_____41. Hexachlorobutadiene
_____42. Hexachlorocyclopentadiene
_____43. Hexachloroethane
_____44. Indeno(1,2,3-c,d)pyrene
_____45. Isophorone
_____46. Naphthalene
_____47. Nitrobenzene
_____48. N-nitrosodimethylamine
_____49. N-Nitroso-di-n-dipropylamine
_____50. Phenanthrene
_____51. Pyrene

TARGET COMPOUND LIST (TCL/HSL/SUPERFUND)
ACID EXTRACTABLES BY GC/MASS
EPA METHODS 625-CLP-M/625/8250/8270
SPECTROPHOTOMETRY MATRIX: WATER/SOIL/SEMISOLID

_____	1.	2,4,5-Trichlorophenol
_____	2.	2,4,6-Trichlorophenol
_____	3.	2,4-Dichlorophenol
_____	4.	2,4-Dimethylphenol
_____	5.	2,4-Dinitrophenol
_____	6.	2-Chlorophenol
_____	7.	2-Methylphenol
_____	8.	2-Nitrophenol
_____	9.	4,6-Dinitro-2-methylphenol
_____	10.	4-Chloro-3-methylphenol
_____	11.	4-Methylphenol
_____	12.	4-Nitrophenol
_____	13.	Benzoic acid
_____	14.	Pentachlorophenol
_____	15.	Phenol

Instructions for Use:

1. If all compounds required leave boxes blank
2. If only certain compounds are required place an X in box next to compound
3. If certain compounds should be deleted from report cross out entire compound with heavy black felt tip pen

PRIMARY DRINKING WATER
METALS
EPA METHODS-VARIOUS

==========

_____1. Arsenic
_____2. Barium
_____3. Cadmium
_____4. Chromium
_____5. Lead
_____6. Mercury
_____7. Selenium
_____8. Silver

==========

Instructions for Use:

1. If all compounds required leave boxes blank

2. If only certain compounds are required place an X in box next to compound

3. If certain compounds should be deleted from report cross out entire compound with heavy black felt tip pen

PRIORITY POLLUTANT - SEMIVOLATILES
BASE/NEUTRAL EXTRACTABLES
EPA METHODS 625/8250/8270
BY GC/MASS SPECTROPHOTOMETRY
MATRIX: WATER/SOIL/SEMISOLID

_____	1.	Acenapthene
_____	2.	Acenaphthylene
_____	3.	Anthracene
_____	4.	Benzidine
_____	5.	Benzo(a)anthracene
_____	6.	Benzo(a)pyrene
_____	7.	Benzo(b)fluoranthene
_____	8.	Benzo(g,h,i)perylene
_____	9.	Benzo(k)fluoranthene
_____	10.	Bis(2-chloroethoxy)methane
_____	11.	Bis(2-chloroethyl)ether
_____	12.	Bis(2-chloroisopropyl)ether
_____	13.	Bis(2-ethylhexyl)phthalate
_____	14.	4-Bromophenyl phenyl ether
_____	15.	Butyl benzyl phthalate
_____	16.	2-Chloronaphthalene
_____	17.	4-Chloropheynyl phenyl ether
_____	18.	Chrysene
_____	19.	Dibenzo(a,h)anthracene
_____	20.	1,2-Dichlorobenzene
_____	21.	1,3-Dichlorobenzene
_____	22.	1,4-Dichlorobenzene
_____	23.	3,3'-Dichlorobenzidine
_____	24.	Diethyl phthalate
_____	25.	Dimethyl phthalate
_____	26.	Di-n-Butyl phthalate
_____	27.	2,4-Dinitrotoluene
_____	28.	2,6-Dinitrotoluene
_____	29.	Di-n-Octyl phthalate
_____	30.	1,2-Diphenylhydrazine
_____	31.	Fluoranthene
_____	32.	Fluorene
_____	33.	Hexachlorobenzene
_____	34.	Hexachlorobutadiene
_____	35.	Hexachlorocyclopentadiene
_____	36.	Hexachloroethane
_____	37.	Indeno(1,2,3-c,d)pyrene
_____	38.	Isophcrone
_____	39.	Naphthalene
_____	40.	Nitrobenzene
_____	41.	N-Nitrosodimethylamine
_____	42.	N-Nitrosodipropylamine
_____	43.	N-Nitrosodiphenylamine
_____	44.	Phenanthrene
_____	45.	Pyrene
_____	46.	1,2,4-Trichlorobenzene

PRIORITY POLLUTANT - SEMIVOLATILES
ACID EXTRACTABLES
EPA METHODS 625/8250/8270
BY GC/MASS SPECTROPHOTOMETRY
MATRIX: WATER/SOIL/SEMISOLID

_____	1.	2-Chlorophenol
_____	2.	2,4-Dichlorophenol
_____	3.	2,4-Dimethylphenol
_____	4.	4,6-Dinitro-2-methylphenol
_____	5.	2,4-Dinitrophenol
_____	6.	2-Nitrophenol
_____	7.	4-Nitrophenol
_____	8.	4-Chloro-3-methylphenol
_____	9.	Pentachlorophenol
_____	10.	Phenol
_____	11.	2,4,6-Trichlorophenol

Instructions for Use:

1. If all compounds required leave boxes blank
2. If only certain compounds are required place an X in box next to compound
3. If certain compounds should be deleted from report cross out entire compound with heavy black felt tip pen

PRIORITY POLLUTANT
EPA METHODS 624/8240/8260
VOLATILE ORGANICS
MATRIX: WATER/SOIL/SEMISOLID

_____	1.	1,1,1-Trichloroethane
_____	2.	1,1,2,2-Tetrachloroethane
_____	3.	1,1,2-Trichloroethane
_____	4.	1,1-Dichloroethane
_____	5.	1,1-Dichloroethene
_____	6.	1,2-Dichloroethane
_____	7.	1,2-Dichloropropane
_____	8.	2-Chloroethyl vinyl ether
_____	9.	Acrolein
_____	10.	Acrylonitrile
_____	11.	Benzene
_____	12.	Bromoform
_____	13.	Bromomethane
_____	14.	Carbon tetrachloride
_____	15.	Chlorobenzene
_____	16.	Chloroethane
_____	17.	Chloroform
_____	18.	Chloromethane
_____	19.	cis-1,3-Dichloropropene
_____	20.	Dibromochloromethane
_____	21.	Dichlorobromomethane
_____	22.	Ethyl Benzene
_____	23.	Methylene chloride
_____	24.	Tetrachloroethene
_____	25.	Toluene
_____	26.	trans-1,2-Dichloroethene
_____	27.	trans-1,3-Dichloropropene
_____	28.	Trichloroethene
_____	29.	Vinyl chloride

Instructions for Use:

1. If all compounds required leave boxes blank
2. If only certain compounds are required place an X in box next to compound
3. If certain compounds should be deleted from report cross out entire compound with heavy black felt tip pen

PRIORITY POLLUTANT
PESTICIDES AND PCBs
EPA METHODS 608/8080
BY GAS CHROMOTOGRAPHY
MATRIX: WATER/SOIL/SEMISOLID

==========

_____1. Aldrin
_____2. alpha-BHC
_____3. beta-BHC
_____4. delta-BHC
_____5. gamma-BHC (Lindane)
_____6. Chlordane
_____7. 4,4'-DDD
_____8. 4,4'-DDE
_____9. 4,4'-DDT
_____10. Dieldrin
_____11. Endosulfan I
_____12. Endosulfan II
_____13. Endosulfan sulfate
_____14. Endrin
_____15. Endrin aldehyde
_____16. Heptachlor
_____17. Heptachlor-epoxide
_____18. PCB-1016
_____19. PCB-1221
_____20. PCB-1232
_____21. PCB-1242
_____22. PCB-1248
_____23. PCB-1254
_____24. PCB-1260
_____25. Toxaphene

==========

Instructions for Use:

1. If all compounds required leave boxes blank

2. If only certain compounds are required place an X in box next to compound

3. If certain compounds should be deleted from report cross out entire compound with heavy black felt tip pen

PRIORITY POLLUTANT METALS
EPA METHODS VARIOUS
MATRIX: WATER/SOIL/SEMISOLID

_____	1.	Antimony
_____	2.	Arsenic
_____	3.	Beryllium
_____	4.	Cadmium
_____	5.	Chromium
_____	6.	Copper
_____	7.	Lead
_____	8.	Mercury
_____	9.	Nickel
_____	10.	Selenium
_____	11.	Silver
_____	12.	Thallium
_____	13.	Zinc

Instructions for Use:

1. If all compounds required leave boxes blank
2. If only certain compounds are required place an X in box next to compound
3. If certain compounds should be deleted from report cross out entire compound with heavy black felt tip pen

PRIORITY POLLUTANTS MISCELLANEOUS
EPA VARIOUS METHODS
MATRIX: WATER/SOIL/SEMISOLID

_____	1.	2,3,7,8-Tetrachlorodibenzo-p-dioxin
_____	2.	Asbestos
_____	3.	Cyanide
_____	4.	Phenols, total

Instructions for Use:

1. If all compounds required leave boxes blank
2. If only certain compounds are required place an X in box next to compound
3. If certain compounds should be deleted from report cross out entire compound with heavy black felt tip pen

APPENDIX IX CONSTITUENTS
SUGGESTED EPA METHODS

MATRIX: WATER/SOIL/SEMISOLID	METHOD	PQL (ug/L)
INORGANICS-METALS:		
_____1. Antimony	7041	30
_____2. Arsenic	7060/7661	10/20
_____3. Barium	6010	20
_____4. Beryllium	7091/6010	2/3
_____5. Cadmium	7131/6010	1/40
_____6. Chromium	7191	10
_____7. Cobalt	7201/6010	10/70
_____8. Copper	6010	60
_____9. Lead	7421/6010	10/40
_____10. Mercury	7470	2
_____11. Nickel	6010	50
_____12. Selenium	7741/7740	20/20
_____13. Silver	6010/7760	70/100
_____14. Thallium	7841	10
_____15. Tin	7870/8000	
_____16. Vanadium	7911/6010	40/80
_____17. Zinc	6010/7950	20/50
VOLATILE ORGANICS:		
_____1. Acetone	8240	100
_____2. Acetonitrile	8240	5
_____3. Acrolein	8015	100
_____4. Acrylonitrile	8240	5
_____5. Allyl chloride	8240	100
_____6. Benzene	8240	5
_____7. Bromodichloromethane	8240	5
_____8. Bromoform	8240	5
_____9. 2-Butonone (MEK)	8240	10
_____10. Carbon disulfide	8240	5
_____11. Carbon tetrachloride	8240	5
_____12. Chlorobenzene	8240	5
_____13. Chloroethane	8240	10
_____14. Chloroform	8240	5
_____15. Chloroprene	8240	5
_____16. Dibromochloromethane	8240	5
_____17. 1,2-Dibromo-3-chloropropane (DBCP)	8240	5
_____18. 1,2-Dibromoethane	8240	5
_____19. trans-1,4-Dichloro-2-butene	8240	5
_____20. Dichlorodifluoromethane	8240	5
_____21. 1,1-Dichloroethane	8240	5
_____22. 1,2-Dichloroethane	8240	5
_____23. 1,1-Dichloroethene	8240	5
_____24. 1,2-Dichloroethene	8240	
_____25. 1,2-Dichloropropane	8240	5
_____26. cis-1,3-Dichloropropene	8240	5
_____27. trans-1,3-Dichloropropene	8240	5

APPENDIX IX CONSTITUENTS
SUGGESTED EPA METHODS

MATRIX: WATER/SOIL/SEMISOLID	METHOD	PQL (ug/L)
VOLATILE ORGANICS (continued)		
_____28. 1,4-Dioxane	8015	150
_____29. Ethylbenzene	8240	5
_____30. Ethyl methacrylate	8240	5
_____31. 2-Hexanone	8240	50
_____32. Isobutyl alcohol	8270	10
_____33. Methacrylonitrile	8015	5
_____34. Methyl bromide (Bromomethane)	8240	5
_____35. Methyl chloride (Chloromethane)	8240	10
_____36. Methylene bromide	8240	5
_____37. Methylene chloride	8240	5
_____38. Methyl ethyl Ketone	8240	100
_____39. Methyl iodide (Iodomethane)	8240	5
_____40. Methyl methacrylate	8015/8240	2/5
_____41. 4-Methyl-2-pentanone (MIBK)	8015	5
_____42. Pentachloroethane	8240/8270	5/10
_____43. Propionitrile	8240/8015	5/60
_____44. Styrene	8240	5
_____45. 1,1,1,2-Tetrachloroethane	8240	5
_____46. 1,1,2,2-Tetrachloroethane	8240	5
_____47. Tetrachloroethene (PCE)	8240	5
_____48. Toluene	8240	5
_____49. 1,1,1-Trichloroethane	8240	5
_____50. 1,1,2-Trichloroethane	8240	5
_____51. Trichloroethene (TCE)	8240	5
_____52. Trichlorofluoromethane	8240	5
_____53. 1,2,3-Trichloropropane	8240	5
_____54. Vinyl acetate	8240	5
_____55. Vinyl chloride	8240	10
_____56. Xylene (total)	8240	5
SEMI-VOLATILES:		
_____1. Acenaphthene	8270	10
_____2. Acenaphthylene	8270	10
_____3. Acetophenone	8270	10
_____4. 2-Acetylaminofluorene	8270	10
_____5. 4-Aminobiphenyl	8270	10
_____6. Aniline	8270	10
_____7. Anthracene	8270	10
_____8. Aramite	8270	10
_____9. Benzo(a)anthracene	8270	10
_____10. Benzo(b)fluoranthene	8270	10
_____11. Benzo(k)fluoranthene	8270	10
_____12. Benzo(ghi)perylene	8270	10
_____13. Benzo(a)pyrene	8270	10
_____14. Benzyl alcohol	8270	20

APPENDIX IX CONSTITUENTS
SUGGESTED EPA METHODS

MATRIX: WATER/SOIL/SEMISOLID	METHOD	PQL (ug/L)
SEMI-VOLATILES (continued)		
_____15. Bis(2-chlorethoxy)methane	8270	10
_____16. Bis(2-chloroethyl)ether	8270	10
_____17. Bis(2-chloro-1-methylethyl)ether	8270	10
_____18. Bis(2-ethylhexyl)phthalate	8270	10
_____19. 4-Bromophenyl phenyl ether	8270	10
_____20. Butyl benzyl phthalate	8270	10
_____21. p-Chloroaniline	8270	20
_____22. Chlorobenzilate	8270	10
_____23. 2-Chloronaphthalene	8270	10
_____24. 4-Chlorophenyl phenyl ether	8270	10
_____25. Chrysene	8270	10
_____26. Diallate	8270	10
_____27. Dibenzo(a,h)anthracene	8270	10
_____28. Dibenzofuran	8270	10
_____29. 1,2-Dichlorobenzene	8270	10
_____30. 1,3-Dichlorobenzene	8270	10
_____31. 1,4-Dichlorobenzene	8270	10
_____32. 3,3'-Dichlorobenzidine	8270	20
_____33. Diethyl phthalate	8270	10
_____34. Dimethoate	8270	10
_____35. p-(Dimethylamino)azobenzene	8270	10
_____36. 7,12-Dimethylbenz(a)anthracene	8270	10
_____37. 3,3'-Dimethylbenzidine	8270	10
_____38. alpha, alpha-Dimethylphenethyl-amine	8270	10
_____39. Dimethyl phthalate	8270	10
_____40. Di-n-butyl phthalate	8270	10
_____41. m-Dinitrobenzene	8270	10
_____42. 2,4-Dinitrotoluene	8270	10
_____43. 4,6-Dinitrotoluene	8270	10
_____44. Di-n-octyl phthalate	8270	10
_____45. Diphenylamine	8270	10
_____46. Ethyl methanesulfonate	8270	10
_____47. Famfur	8270	10
_____48. Fluroanthene	8270	10
_____49. Fluorene	8270	10
_____50. Hexachlorobenzene	8270	10
_____51. Hexachlorobutadiene	8270	10
_____52. Hexachlorocyclopentadiene	8270	10
_____53. Hexachloroethane	8270	10
_____54. Hexachloropropene	8270	10
_____55. Indeno(1,2,3-cd)pyrene	8270	10
_____56. Isodrin	8270	10
_____57. Isophorone	8270	10
_____58. Isosafrole	8270	10
_____59. Kepone	8270	10
_____60. Methapyrilene	8270	10
_____61. 3-Methylcholanthrene	8270	10

APPENDIX IX CONSTITUENTS
SUGGESTED EPA METHODS

MATRIX: WATER/SOIL/SEMISOLID	METHOD	PQL (ug/L)
SEMI-VOLATILES (continued)		
_____62. Methyl methanesulfonate	8270	10
_____63. 2-Methylnaphthalene	8270	10
_____64. Naphthalene	8270	
_____65. 1,4-Naphthoquinone	8270	10
_____66. 1-Naphthylamine	8270	10
_____67. 2-Naphthylamine	8270	10
_____68. 2-Nitroanaline	8270	50
_____69. 3-Nitroanaline	8270	50
_____70. 4-Nitroanaline	8270	50
_____71. Nitrobenzene	8270	10
_____72. 4-Nitroquinoline-1-oxide	8270	10
_____73. 5-Nitro-o-toluidine	8270	10
_____74. N-Nitrosodi-n-butylamine	8270	10
_____75. N-Nitrosodiethylamine	8270	10
_____76. N-Nitrosodimethylamine	8270	10
_____77. N-Nitrosodiphenylamine	8270	10
_____78. N-Nitrosodipropylamine	8270	10
_____79. N-Nitrosomethylethylamine	8270	10
_____80. N-Nitrosomorpholine	8270	10
_____81. N-Nitrosopiperidine	8270	10
_____82. N-Nitrosopyrrolidine	8270	10
_____83. O,O-Diethyl-O-2-pyrazinyl phosphorothioate (Thionazine)	8270	10
_____84. Parathion	8270	10
_____85. Pentachlorobenzene	8270	10
_____86. Pentachloroethane	8270	5
_____87. Pentachloronitrobenzene	8270	10
_____88. Phenacetin	8270	10
_____89. Phenanthrene	8270	10
_____90. p-Phenylenediamine	8270	10
_____91. 2-Picoline	8240/8270	5/10
_____92. Pronamide	8270	10
_____93. Pyrene	8270	10
_____94. Pyridine	8270	10
_____95. Safrole	8270	10
_____96. Sulfotepp	8270	10
_____97. 1,2,4,5-Tetrachlorobenzene	8270	10
_____98. Tetraethyl dithiopyrophosphate	8270	10
_____99. o-Toluidine	8270	10
_____100. 1,2,4-Trichlorobenzene	8270	10
_____101. O,O,O-Triethyl phosphorothioate	8270	10
_____102. sym-Trinitrobenzene	8270	10

APPENDIX IX CONSTITUENTS
SUGGESTED EPA METHODS

MATRIX: WATER/SOIL/SEMISOLID		METHOD	PQL (ug/L)
SEMI-VOLATILES-ACID EXTRACTABLES			
ACIDS:			
_____1.	p-Chloro-m-cresol	8270	20
_____2.	2-Chlorophenol	8270	10
_____3.	m-Cresol	8270	10
_____4.	o-Cresol	8270	10
_____5.	p-Cresol	8270	10
_____6.	2,4-Dichlorphenol	8270	10
_____7.	2,6-Dichlorphenol	8270	10
_____8.	2,4-Dimethylphenol	8270	10
_____9.	4,6-Dinitro-o-cresol	8270	50
_____10.	2,4-Dinitrophenol	8270	50
_____11.	Hexachlorophene	8270	10
_____13.	2-Nitrophenol	8270	10
_____14.	4-Nitrophenol	8270	50
_____15.	Pentachlorophenol	8270	50
_____16.	Phenol	8270	10
_____17.	2,3,4,6-Tetrachlorophenol	8270	10
_____18.	2,4,5-Trichlorophenol	8270	10
_____19.	2,4,6-Trichlorophenol	8270	10
ORGANOCHLORINE PESTICIDES AND PCBS:			
_____1.	4,4'-DDD	8080	0
_____2.	4,4'-DDE	8080	0
_____3.	4,4'-DDT	8080	0
_____4.	Aldrin	8080	0
_____5.	BHC-alpha	8080	0
_____6.	BHC-beta	8080	0
_____7.	BHC-delta	8080	0
_____8.	BHC-gamma (Lindane)	8080	0
_____9.	Chlordane	8080	0
_____10.	Dieldrin	8080	0
_____11.	Disulfoton	8270	10
_____12.	Endosulfan I	8080	0
_____13.	Endosulfan II	8080	0
_____14.	Endosulfan sulfate	8080	1
_____15.	Endrin	8080	0
_____16.	Endrin aldehyde	8080	0
_____17.	Heptachlor	8080	0
_____18.	Heptachlor epoxide	8080	1
_____19.	Methoxychlor	8270	10
_____20.	Methyl parathion	8270	10
_____21.	Phorate	8270	10
_____22.	Polychlorinated biphenyls (PCBs)	8080	50
_____23.	Toxaphene	8080	2

APPENDIX IX CONSTITUENTS
SUGGESTED EPA METHODS

MATRIX: WATER/SOIL/SEMISOLID		METHOD	PQL (ug/L)
POLYNUCLEAR AROMATIC HYDROCARBONS:			
_____1.	Naphthalene	8100	200
CHLORINATED HERBICIDES:			
_____1.	2,4,5-T, 2,4,5-Tichlorophenoxy-acetic acid	8150	2
_____2.	2,4-D	8150	10
_____3.	Silvex, 2,4,5-TP	8150	2
_____4.	2-sec-Butyl-4,6-dinitrophenol (Dinoseb or GNBP)	8150/8270	1/10
POLYCHLORINATED DIBENZO-P-DIOXINS AND POLYCHLORINATED DIBENZOFURANS			
_____1.	2,3,7,8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD)	8280	0
_____2.	Polychlorinated dibenzofurans (PCDFs)	8280	0
_____3.	Polychlorinated dibenzo-p-dioxins (PCDDs)	8280	0
MISCELLANEOUS:			
_____1.	Cyanide	9010	40
_____2.	Sulfide	9030	10000

Instructions for Use:

1. If all compounds required leave boxes blank
2. If only certain compounds are required place an X in box next to compound
3. If certain compounds should be deleted from report cross out entire compound with heavy black felt tip pen

TARGET COMPOUND LISTS FOR AIR TOXICS STATEMENT OF WORK

Volatiles

Substance	CAS	Rank in Target Compound List	Sampling/Analytical Methods C-GC/MS	T-GC/MS
Vinyl Chloride	75014	1	X	
Trichloroethylene	79016	2	X	X
Chloroform	67663	4	X	X
Benzene	71432	5	X	X
Carbon Tetrachloride	56235	6	X	X
Tetrachloroethylene	127184	8	X	X
1,1-Dichloroethene	75354	15	X	X
*Acrylonitrile	107131	16	X	X
1,2-Dichloroethane	107062	18	X	X
Chlorobenzene	108907	19	X	X
1,1,1-Trichloroethane	71556	22	X	X
1,1,2-Trichloroethane	79065	23	X	X
1,1,2,2-Tetrachloroethane	79435	25	X	X
Ethylbenzene	100414	27	X	X
Methylene chloride	75092	31	X	
1,2,4-Trichlorobenzene	120821	33	X	
Styrene	100425	34	X	X
1,1-Dichloroethane	75343	35	X	X
Toluene	108883	39	X	X
Xylenes, o-, m-, and p-	1330207	40	X	X
1,2-Dichloropropane	78875	41	X	X
1,2-Dichlorobenzene	95501	42	X	X
1,2-Dibromoethane	106934	43	X	X
*1,3-Butadiene	106990	44	X	
*Acetone	67641	49	X	
Chloroethane	75003	50	X	
*2-Butanone	78933	54	X	X
*Acroiein	107028	58	X	
Benzyl chloride	100447	61	X	
*Carbon disulfide	75150	63	X	
*4-Methyl-2-pentanone	108101	66	X	
cis-1,3-Dichloropropene	10061015	69	X	X
*trans-1,2-dichloroethylene	156605	71	X	
1,4-Dichlorobenzene	106467	75	X	X
1,4-Dioxane	123911	76		X
Hexachlorobutadiene	87683	82	X	
Bromomethane	74839	86	X	
trans-1,3-Dichloropropene	10061026	88	X	X
Dichlorodifluoromethane	75718	90	X	

*These compounds are reported in the literature to be amenable to sampling and analysis by the indicated method(s), but precision and accuracy have not been established by USEPA.

TARGET COMPOUND LISTS FOR AIR TOXICS STATEMENT OF WORK

Volatiles

(Continued)

Substance	CAS	Rank in Target Compound List	Sampling/Analytical Methods C-GC/MS	T-GC/MS
[illegible]methane	[illegible]873	[illegible]	X	
cis-1,2-Dichloroethylene	156592	97	X	
*Methanol	67561	100	X	X
*Bromodichloromethane	75274	101	X	X
Tribromomethane	75252	103		X
*Acetonitrile	75058	104	X	X
1,3-Dichlorobenzene	541731	105	X	X
*Pyridine	110861	108		X
3-Chloro-1-propene	107051	112	X	X
*Dibromochloromethane	124481	116	X	X
*Methyl methacrylate	80626	118	X	
*1,2-Dibromo-3-chloropropane	96128	121		X
Tetrahydrofuran	109999	122		X
Bromoethane	74839	123		X
*2-Chloro-1,3-butadiene	126998	124		X
*Vinyl acetate	108054	125	X	
*trans-1,4-Dichlorobutene	110576	130		X
Bromochloromethane	74975	131		X
*Propylene	115071	134	X	X
1,1,2-Trichloro-1,2,2-trifluoroethane	76131	135	X	
*Propanal	123386	138	X	X
Trichlorofluoromethane	75694	147	X	
1,2,3-Trichloropropane	96184	148		X
Isopropylbenzene	98828	154	X*	X
*Heptane	142825	163	X	X
2-Chloropropane	75296	173		X
*2-Chloroethyl vinyl ether	110758	179		X
*Octane	111659	182	X	X
*Chlorodifluoromethane	75456	183	X	
Bromobenzene	108861	190		X
*Methyl styrene	98839	195	X	
*n-Pentane	109660	214	X	X
*2-Hexanone	591786	215		X
*Hexane	110543	232	X	X
*Cyclohexanone	108941	233		X
*1-Bromobutane	109659	238		X
*2-Methylnaphthalene	91576	249		X
1,2-Dichloro-1,1,2,2-tetrafluoroethane	1320372		X	
1,4-Dichloro-2-Butene	764410			X
1-Bromo-3-chloropropane	NA			X
1,3,4-Trimethylbenzene	NA			X
(1-Methylethyl)Benzene	98828			X

TARGET COMPOUND LISTS FOR AIR TOXICS STATEMENT OF WORK

Volatiles

(Continued)

Substance	CAS	Rank in Target Compound List	Sampling/Analytical Methods C-GC/MS	T-GC/MS
1-Methyl-4-(1-methylethyl)benzene	NA			
1-Ethenyl-4-chlorobenzene	NA			X
Bromotrichloromethane	NA			X
Pentachloroethane	76017			X
1-Chloropropane	NA			X
1,2-Dibromopropane	NA			X
2,3-Dichlorobutane	NA			X
2-Chlorobutane	NA			X
1,3-Dichlorobutane	NA			X
1,4-Dichlorobutane	NA			X
3,4-Dichloro-1-butene	NA			X
1-Chloro-2,3-epoxypropane	NA			X
2-Chloroethoxyethene	NA			X
1-Phenylethanone	NA			X
**2,2-Dichloropropane	NA			
**1,1-Dichloropropene	NA			
Dibromomethane	NA			X
1,3-Dichloropropane	142289			X
1,1,1,2-Tetrachloroethane	630206			X
**n-Propylbenzene	103651			
**o-Chlorotoluene	95498			
1,3,5-Trimethylbenzene	NA		X	X
**p-Chlorotoluene	106434			
**tert-Butylbenzene	98066			
1,2,4-Trimethylbenzene	NA		X	X
**sec-Butylbenzene	135988			
**p-Isopropyltoluene				
n-Butylbenzene	104518			X
**1,2,3-Trichlorobenzene				

**These compounds are listed to accommodate regional requirements, but sampling and analysis of the compounds by the designated methods could not be identified in the usual literature references.

TARGET COMPOUND LISTS FOR AIR TOXICS STATEMENT OF WORK

Semivolatiles

Sampled and Analyzed by PUF/XAD-2-GC/MS

Substance	CASRN	Rank In Target Compound List
Benzo(a)Pyrene	50328	17
Naphthalene	91203	37
*Nitrobenzene	98953	55
*Hexachlorocyclopentadiene	77474	57
*Hexachlorobenzene	118741	59
*Pentachlorophenol	87865	62
Fluorene	86737	74
*Aniline	62533	81
Benzo(b)fluoranthene	205992	95
Benzo(a)anthracene	56553	107
Dibenzo(a,h)anthracene	53703	113
Benzo(k)fluoranthene	207089	115
Anthracene	120127	119
*4-Chloroaniline	106478	127
*Benzidene	92875	132
Acenaphthylene	208968	136
Benzo(g,h,i)perylene	191242	137
Phenanthrene	85018	142
Pyrene	129000	146
*2,4,6-Trichlorophenol	88062	151
*2,4-Dinitrotoluene	121142	152
Indeno(1,2,3-c,d)pyrene	193395	156
*Dibenzofuran	132649	159
Chrysene	218019	161
*Hexachloroethane	67721	166
*2,4,5-Trichlorophenol	95954	167
*Diethyl Phthalate	84662	170
* -Napthylamine	91598	177
*Bis(2-ethylhexyl)phthalate	117817	178
*Isophorone	78591	184
*Di(n-octyl)phthalate	117840	186
*Nitrophenol	25154556	187
Acenaphthene	83329	188
*Di(2-chloroethyl)ether	111444	189
*Butylbenzylphthalate	85687	192
Fluoranthene	206440	193

*These compounds are reported in the literature as amenable to sampling and analysis by PUF/XAD-2-GC/MS, but precision and accuracy have not been stablished by USEPA.

TARGET COMPOUND LISTS FOR AIR TOXICS STATEMENT OF WORK

Semivolatiles

Sampled and Analyzed by PUF/XAD-2-GC/MS
(Continued)

Substance	CAS No.	Rank In Target Compound List
*2-Nitrophenol	88755	196
*2,4-Dimethyl phenol	105679	197
*2,4-Dinitrophenol	51285	206
*2-Nitroaniline	88744	211
*3-Nitroaniline	100016	212
*4-Nitrodiphenyl	92933	216
*p-Biphenylamine	92671	217
*Di(n-butyl)phthalate	84742	222
*Creosote	8001589	223
*Acetophenone	98862	226
*Di(2-chloroethoxy)methane	111911	227
*4,6-Dinitro-2-methylphenol	534521	231
*Dimethylphthalate	131113	235
*4-Chloro-3-methylphenol	59507	240
*4-Methyl phenol	106445	246
*2-Methyl phenol	95487	247
*Benzyl alcohol	100516	248
*2-Methylnaphthalene	91576	249
Benzo(e)pyrene	192972	

TARGET COMPOUND LISTS FOR AIR TOXICS STATEMENT OF WORK

Pesticides/PCBs/PBBs

Sampled and Analyzed by PUF/XAD-2-GC/MS

Pesticide	CASRN	Ranked in Target Compound List
Heptachlor	76448	14
Heptachlor Epoxide	1024573	14
-Chlordane	57749	24
-Chlordane	NA	24
*Chlordane (Technical)	57749	24
PCBs	11096825	28
	11097691	
	12672296	
	53469219	
	11141165	
	11104282	
	12674112	
*Toxaphene	8001352	30
Aldrin	309002	56
Dieldrin	60571	56
*4,4'-DDE	72559	64
*4,4'-DDD	72548	64
*4,4'-DDT	50293	64
Methoxychlor	72435	89
Parathion	56382	91
-BHC	319846	109
-BHC (Lindane)	58899	109
Endosulfan I	959988	110
Endosulfan II	33213659	110
Endrin Aldehyde	7421934	117
Endrin	72208	117
Mirex	2385855	120
Aldicarb	116063	140
Polybrominated biphenyls	59536651	145
Malathion	121755	165
Disulfoton	298044	194
Carbaryl	63252	218
*2,4,5-Trichlorophenoxy acetic acid	93765	219
Auramine	492808	220
Atrazine	1912249	225
Aramite	140578	237
2,4,5-TP (Silvex)	93721	241
Pentachlorobenzene	608935	243
Dichlorvos (DDVP)	62737	
Hexachlorobenzene	118741	
Chlorothalonil	1897456	

*These compounds are not readily quantitated by GC/MS as configured for the Pesticides Statement of Work.

TARGET COMPOUND LISTS FOR AIR TOXICS STATEMENT OF WORK

Pesticides/PCBs/PPBs

Sampled and Analyzed by PUF/XAD-2-GC/MS
(Continued)

Pesticide	CASRN	Ranked in Target Compound List
Ronnel	299843	
Dacthal (DCPA)	1861321	
Chlorpyrifos	2921882	
Oxychlordane	NA	
2,4-D Butoxy Ethyl Ester	NA	
Captan	133062	
Folpet	133073	
Dicofol	115322	
cis/trans-Permethrin	52645531	
o-Phenylphenol	90437	
Propoxur	114261	
Bendiocarb	22781233	
Diazinon	333415	
Resmethrin	NA	
Endrin ketone	533415	

QAPP ATTACHMENTS

(See Book 2 of Volume 4)

APPENDIX 4.4.2

Basic Field Sampling Plan (BFSP)

BASIC SAMPLING AND ANALYSIS PLAN
BASIC FIELD SAMPLING PLAN
AT THE NAVAL AIR STATION
JACKSONVILLE, FLORIDA

Prepared for:

SOUTHERN DIVISION
DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND
CHARLESTON, SOUTH CAROLINA

September 1991

Prepared by:

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Revision 1

BASIC SAMPLING AND ANALYSIS PLAN
BASIC FIELD SAMPLING PLAN
AT THE NAVAL AIR STATION
JACKSONVILLE, FLORIDA

Prepared for:

SOUTHERN DIVISION
DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND
CHARLESTON, SOUTH CAROLINA

February 1992

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CONTENTS (Continued)

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1.0 GENERAL CONSIDERATIONS

This Basic Field Sampling Plan (BFSP) has been prepared as Part 2 of the Basic Sampling and Analysis Plan (BSAP), for the Installation Restoration Program (IRP) being conducted at the Naval Air Station, Jacksonville, Florida. Part 1 of the BSAP is the Quality Assurance Program Plan (QAPP) which serves as the source of quality control information and guidance for the entire Site Work Plan. The QAPP is a document designed to provide quality control information for field and laboratory activities.

The BFSP has been prepared to define the specific sampling procedures and techniques that may be employed in the collection of environmental samples. The BFSP covers the broad multitude of procedures that may be carried out in the field and is intended to serve as a guide for field sampling personnel. This guidance will make the field personnel aware of the factors affecting the sampling so he or she can plan, correct, or adjust a program in accordance with specified procedures to assure an accurate representation of existing conditions and the proper completion of designated scopes of work.

The BFSP describes methods for geophysical surveying, test pit excavation, drilling of soil borings, monitor well installation, in-situ permeability testing, and sampling and field measurement procedures for soil, sediment, sludge, ground water, surface water, waste material, and ambient air. Although all sampling and analyses will be performed in accordance with the procedures and methods specified in this document, governed by the QAPP, not all of the techniques presented are anticipated to be used at each operable unit (OU) or potential source of contamination (PSC). Selection of specific data gathering methodologies will be made for each by preparation of OU-specific Field Sampling Plans (OU FSPs) and OU-specific Quality Assurance Project Plans (QAPjPs). These documents will be prepared for each OU at the Site. The

methodologies used for each OU investigation will be incorporated into the OU FSPs and QAPjP. When OU conditions require modifications to techniques documented in the QAPP and BFSP, or require the use of specialized procedures not presented in these documents, the OU-specific plans will provide a detailed description of the proposed technique and the technical justification for its use.

1.1 Project Objectives

The principal objectives of RI/FS for selected OUs and the surrounding Site areas are:

(1) determine the extent (vertical and horizontal) and concentration of detected contaminants;

(2) identify and characterize the sources of contamination;

(3) assess the potential for contaminant migration to surrounding environments;

(4) identify public health and environmental risks associated with the identified contaminants; and

(5) define the scope of future investigations and/or required remedial actions, if warranted.

To accomplish these objectives, the contractor will perform numerous field tasks including the following types of field techniques:

- Geophysical Surveys
  - Magnetic surveys
  - Electromagnetic surveys
  - Seismic surveys
  - Resistivity studies

- o Radiological Surveys
- o Test Pit Excavations
- o Surveys for Water Level Elevation Measurements
- o Hydrologic (aquifer) Testing
- o Sampling and Analysis
  - Surface soil
  - Subsurface soil
  - Sediment
  - Surface water
  - Ground water
  - Waste stream/water
  - Waste/sludge
  - Ambient air

1.2 Task Specific Objectives

The purpose and use of the data for each type of field sampling task anticipated to be performed at the installation is described below.

1.2.1 Geophysical Surveys

Geophysics comprises a number of fundamental methods used to obtain the physical quantities of the earth. Within each method there are usually a number of techniques commonly used and each technique requires that the measurements be taken using specific parameters. In addition, every geophysical survey is tailored to each specific target and local geology. Finally, all geophysical methods are subject to noise interference from many sources. Because of all of the above factors, the best quality control is to have a trained geophysicist set up the survey and ascertain that

correct data is being collected. Once this is done quality control for the remainder of a specific survey can be established. Because of the above factors, the discussions presented below are somewhat general and more specifics are discussed in later sections.

1.2.1.1 Magnetic Geophysical Methods. Magnetic methods are used to search for buried metal, frequently drums and tanks. The method can also be used to evaluate regional geologic structures. Magnetic readings measure the strength of the magnetic field at points a few feet apart across an area. Buried metal will show up as regions of discontinuous magnetic field strength. The final result is a contour map of magnetic field strength. It is also common to measure the vertical gradient of the magnetic field at the same time as the total field since it takes little more time and provides and additional check on the data quality.

1.2.2 Radiological Surveys

Based on historical data for each PSC, radiological surveys as described in the Radiological Plan will be conducted at the appropriate sites. The survey grid and survey equipment will be selected based on the radionuclides suspected to have been present at the site. Typically gamma survey equipment will be utilized due to its wide area coverage and its ability to detect many natural and man-made nuclide.

The results of the radiological survey of each site will be compared to a background survey to determine if detected radionuclides are a function of areal characteristics or due to the presence of specific radionuclides at the site. This data will be used for health and safety purposes as well as to assess the regulatory status of the source material. Because radiological surveys cannot detect certain alpha and beta emitting radioisotopes at levels that exceed drinking water MCLs, laboratory gross alpha

and gross beta scans may be required at sites where radionuclides are known to have been stored.

The objective of the radiological investigation is to evaluate a selected site for its radiological condition. The primary tasks performed in achieving this objective may include the following:

(1) review of available PSC information,

(2) evaluation of hazards associated with identified radionuclides,

(3) gamma radiation PSC surveys,

(4) collection of water and soil samples,

(5) determination of background radioactivity levels,

(6) analysis of water and soil samples for radioactivity parameters, and

(7) comparison of PSC radioactivity levels to background levels.

The details for conducting the site radiological investigations are presented in the Radiological Investigation Plan. Based on the results of the radiological investigation and an evaluation of the site history, environmental samples for radiochemistry analysis will be collected as described in Section 4.0.

1.2.3 Test Pit Excavations

At sites where the historical information or geophysical surveys indicate the presence of significant quantities of buried

solid waste, test pit excavations may be conducted. The dimensions and depth of the excavations will be dependent on the previous disposal practices and the size of the site. Typically, excavations are conducted to a maximum practical depth of 10 to 15 feet (ft) below land surface (bls) or to the water table, whichever is less.

The object of the excavations is to provide descriptive information and allow sampling and chemical analysis of each type of waste observed at the site. Since the final use of the data is to allow the Contractor to characterize the waste, the test pits will be located as close as possible to most active disposal areas.

Specific procedures to be used during test pit excavations will be described in each FSP and QAPjP. Decontamination procedures used on excavation equipment will be similar to those followed for drilling equipment and are presented in Attachment A.

1.2.4 Soil Borings and Geotechnical Measurements

Soil borings are drilled for many reasons. Some of those reasons include: (1) evaluate the site geology/lithology; (2) determine the location of confining units; (3) determine thickness of water bearing units (aquifers); (4) provide subsurface soil samples for soil clarification tests (geotechnical tests); (5) conduct field screening analyses; (6) collection of soil samples for laboratory chemical analysis; and, (7) construction of ground water production and monitor wells.

The purpose of developing geotechnical data is to provide information for the remedial design activities with regard to the soil classification and physical properties of materials present at the PSC as well as to identify profiles of the underlying stratigraphy. To obtain this information various geotechnical tasks and tests will be performed. Selected samples will be

collected of soils for geotechnical testing. Geotechnical sampling will be performed in accordance with the ASTM methods and EPA Compendium identified in Table 2 of the QAPP. Geotechnical samples shall be sealed, shipped, and stored in accordance with procedures described in the QAPP.

1.2.5 Surveys for Water-Level Measurements

The measurement of water levels is a critical aspect of any ground-water investigation. Water-level measurements are required during the course of the investigation to determine the ground-water flow direction.

1.2.6 Hydrogeologic (Aquifer) Testing

Aquifer tests such as pumping tests or slug tests are conducted to determine the capacity of a well and the hydraulic characteristics of the aquifer. The hydraulic characteristics include a determination of the aquifer transmissivity, storativity, porosity, and other factors. Using these hydraulic characteristics it is possible to calculate the rate of ground-water flow and specific well yields. This information will be used to identify potential contaminant receptor locations, determine the time for contaminant migration and the requirements for design of ground-water recovery wells to be installed for remediation of ground water.

1.2.7 Monitor Well Installation and Ground-water Sampling

Ground-water sampling may be required for a variety of reasons, such as examining potable or industrial water supplies, checking for and/or tracking contaminant plume movement in the vicinity of a PSC, RCRA compliance monitoring, or examining a site where historical information is minimal or non-existent, but where it is thought ground-water contamination could have occurred.

Ground water is usually sampled through monitor wells. However, it can also be sampled anywhere ground water is present, as in a pit or a dug trench or drilled hole. Methods for sampling ground water are described in Section 4.5.

1.2.7.1 Site Selection. The relationship of the following factors to potential sources of contamination shall be considered and evaluated when selecting ground-water sampling sites: the direction of ground-water flow; depth to ground water; thickness of the aquifer (if applicable); type of stratigraphy; presence of perched water tables; types of soils; depth to bedrock; type of vegetation; surface drainage patterns; type of topography; general land use; and surface features such as rock outcrops, seeps, springs, streams, rivers, and wet areas. The area of interest will be located on an aerial photograph, a USGS 7.5 minute quadrangle map, and/or any other appropriate map that shows topography and general relationships between surface features. USGS 7.5 minute quadrangle maps can be acquired form the State Geological Survey or from the USGS, and soils maps from the USDA-SCS. A visual inspection of the area may be sufficient to evaluate and determine the surface conditions and their relationship to the subsurface conditions. In some cases, surface conditions and subsurface conditions cannot be correlated by site inspection or reconnaissance. When this occurs, a more detailed study, possibly involving test drilling, will have to be conducted.

It is extremely important to sample the unconfined or surficial aquifer downgradient of PSCs or spills to determine if this aquifer has been affected. If a shallow aquifer is involved in the zone of interest, a study will reveal whether or not deeper aquifers need to be sampled.

To assess subsurface conditions, a minimum of four wells are required, one in the upgradient portion of the area of interest two in the downgradient portion, and a fourth well installed in the

center of the site. In some cases, a more complex system of wells may be needed to define the subsurface conditions, especially in establishing the depth to the shallow ground-water aquifer and direction of ground-water movement. Site conditions and the scope of the project will determine the total number of wells required. Existing wells should be used when possible. Where well installation is necessary, the wells should be installed according to the procedures described in the Hydrogeologic Plan. These procedures are briefly described here.

1.2.7.2 Monitoring-Well Installation. Wells shall be dug, driven, drilled, or bored depending on the scope of work. Hand equipment such as augers, post-hole diggers, picks, and shovels can be used to dig shallow wells in soft soils. Wells can also be installed by driving a piece of casing connected to a well point into the ground with an axe, sledge hammer, or mechanical or power device. Power equipment such as drilling rigs can be used to drill or auger wells in all types of soils and to any depth. Monitor well screen and casing will be decontaminated prior to installation. Where feasible the following procedures shall be used for well installation:

(a) Monitoring Wells. For very shallow wells (<15 feet below land surface) in soft material, hand augers or small portable power augers shall be used for boring. A PVC well casing with a well screen attached shall be installed as soon as the hole is augered.

(b) Permanent Monitoring Well. Permanent monitoring wells shall be installed using one or more of the techniques described in the Hydrogeologic Investigation Plan. Casings with well screens shall be installed in unconsolidated and semi-consolidated soils to prevent soil and other foreign material from entering the well during pumping. Screens may or may not be required for

wells in rock. The space surrounding the screen will be backfilled with pre-washed sand and the remainder of the space surrounding the casing above the screen will be backfilled with bentonite and/or cement bentonite grout, depending on the conditions at the PSC. Well casings and screens will be PVC.

(c) Monitoring Well Security. Wells will be capped and locked at the conclusion of sampling. If the well will not be used for sampling in the future, it will be properly abandoned by backfilling with suitable permanent fill materials such as concrete, bentonite, compactable soil, or a combination of these materials using the tremie method.

1.2.7.3 Monitoring Well Development. Permanent wells shall be adequately developed and measurements of pH and specific conductivity stabilized prior to the initial sampling efforts. Adequate development should eliminate fine-material from the area of the well screen and allow for the collection of a sample which is free relatively of suspended materials. Wells installed by "wet drilling" where drilling muds are used shall be developed so that residual drilling muds will not settle around the well screens or in the surrounding soil and contaminate future sampling.

Various methods may be used to develop wells. These methods consist of suction lift pumping, pressure ejection pumping, submersible pumping, surge blocks, and bailing.

1.2.7.4 Boring Log. It is imperative that drilling logs be concise, complete, and described in a manner that is easily understood to all who read them. The following items shall be included in the logging data:

(1) hole number and location;

(2) description of soils and subsurface conditions (if applicable);

(3) type of drilling equipment, driller, and drilling company (if applicable);

(4) method of drilling;

(5) type and size of casing;

(6) type and size of well screen;

(7) depth to well screen;

(8) type of pump and pumping rate;

(9) drilling and sampling times;

(10) depth to water table, and date and time measured;

(11) type of samples taken and depths taken;

(12) volume of water purged;

(13) type of well (permanent or temporary);

(14) type of sampling equipment and/or cleaning procedure; and

(15) depth of sampling and description (if applicable).

1.2.8 Surface Water Sampling

Selection of a surface water sampling locations at Jacksonville NAS will be based on the following factors.

1.2.8.1 Sample Site Selection. Before any sampling is conducted, an initial reconnaissance should be made to locate suitable sampling locations. Bridges and piers are normally good choices as sites since they provide ready access and permit water sampling at any point across the width of the water body. However, these structures may alter the nature of water flow and thus cause sediment deposition or scouring. Additionally, bridges and piers are not always located in desirable locations with reference to waste sources, tributaries, etc. Wading for water samples is not recommended in lakes, ponds, and slow-moving rivers and streams because bottom deposits are easily disturbed, thereby resulting in increased sediment in the overlying water column. On the other hand, wadeable areas may be best for sediment sampling. In slow-moving or deep water, a boat is usually required for sampling.

Fresh water environments are commonly separated into two types: (1) rivers, streams, and creeks; and (2) lakes, ponds, and impoundments. Since these waterways differ considerably in general characteristics, site selection must be adapted to each. Estuarine environments are a special case and are discussed separately.

1.2.8.2 Rivers, Streams, and Creeks. In the selection of a surface water sampling site on rivers, streams, and creeks, areas that exhibit the greatest degree of cross-sectional homogeneity shall be located. When available, previously collected data may indicate if potential sampling locations are well mixed or vertically or horizontally stratified. Since mixing is principally governed by turbulence and water velocity, the selection of a site immediately downstream of a ripple area will ensure good vertical mixing. These locations are also likely areas for deposition of

sediment since the greatest deposition occurs where stream velocity slows down. Horizontal (cross-channel) mixing occurs in constrictions in the channel, but because of velocity increases, the stream bottom may be scoured, and therefore, a constriction is a poor sediment sample location. In the absence of turbulent areas, the selection of a site that is clear of immediate point sources, such as tributaries and industrial and municipal effluents, is preferred for the collection of water samples.

Typical sediment depositional areas are located inside of river bends, downstream of islands, and downstream of obstructions in the water. Sites that are located immediately upstream or downstream from the confluence of two streams or rivers should generally be avoided since flows from two tributaries may not immediately mix, and the sediment may be moving almost as two streams in proportion to the inflow from the tributaries. Potential sites upstream from the confluence with another stream may also be unsuitable at times due to possible backflow which can upset the normal movement of sediment. When several stations along a stream reach are to be sampled, they should be strategically located:

(1) They shall be spaced at intervals based on time-of-water travel, not distance. A general rule of thumb is about one-half day time-of-water-travel for the first three days downstream of a waste source and approximately one day through the remaining distance.

(2) If the study is to be compared to a previous study, the same sampling stations should be used, if possible, for comparison purposes.

(3) A station should be located whenever a marked physical change occurs in the stream channel. Example: A stream reach between two adjacent stations should not include

both a long rapids section of swift shallow water with a rocky bottom, and a long section of deep, slow-moving water with a muddy bottom. Stations at each end of the combined reach would yield data on certain rates of change, such as re-aeration, that would be an unrealistic average of two widely different rates. Much more would be learned of the actual natural characteristics of the stream by inserting a third sampling station within the reach, between the rapids and the quiet water sections.

Dams and weirs cause changes in physical characteristics of a stream that may be similar to the above rapids-quiet water situation. They usually create quiet, deep pools in river reaches that, by comparison, formerly were swift and shallow. Such impoundments should be bracketed. When times of water travel through them are long, stations should be established within the impoundments.

Some stream structures, such as dams, permit overflow that accomplishes significant re-aeration of oxygen deficient water. In such cases, stations should be located short distances upstream and downstream from the structures to measure the rapid, artificial increase in dissolved oxygen (DO), which is not representative of natural re-aeration.

A minimum of three stations located between any two points of major change in a stream is a desirable precaution, when feasible, even when the time-of-travel between the points of change is short. Major changes may consist of a waste discharge, a tributary inflow, or a significant difference in channel characteristics. The use of three stations is especially important when rates of change of unstable constituents are being determined. If results from one of only two stations in a subreach are in error for some unforeseen reason, it may not be possible to judge which of the two sets of results indicate the actual rate of change. Results from at least

two of three stations, on the other hand, will probably support each other and indicate the true pattern of water quality in the subreach.

If there is interest in the effects of certain discharges or tributary streams on ambient water quality, sites should be located both upstream and downstream from the tributaries or discharges.

Unless a stream is extremely turbulent, it is nearly impossible to measure the effect of a waste discharge or tributary immediately downstream. Inflow frequently hugs the stream bank with very little lateral mixing for some distance. This is a major consideration in estuarine environments. Samples from quarter points may miss the wastes altogether and reflect only the quality of water above the waste source. Samples taken directly in the portion of the cross section containing the wastes would indicate excessive effects of the wastes with respect to the river as a whole.

The station on a tributary should be as near the mouth as is feasible. This may be a bridge some distance upstream from the mouth. Frequently, the mouths of tributaries may be entered from the main stream for sampling when collection in the main stream is by boat. Care should be exercised to avoid collecting water from the main stream that may flow into the mouth of the tributary on either the surface or bottom because of differences in density resulting from temperature, dissolved salts, or turbidity.

Actual sampling locations will vary with the size of the water body and the amount of turbulence in the stream or river. Generally, with small streams less than 20 feet wide, a sampling site can be found where the water is well mixed. In such cases, a single grab sample taken at mid-depth in the center of the channel is adequate to represent the entire cross-section. A sediment sample also can be collected at the center of the channel. For

slightly larger streams, at least one vertical composite should be taken from mid-stream, with samples taken just below the surface, at mid-depth, and just above the bottom. Of course, the DO, pH, temperature, conductivity, etc. should be measured for each aliquot of the vertical composite. The measurement of such parameters on the vertical composite is not generally useful and is not conducted. For rivers, several verticals should be sampled. These vertical composites should be located in a manner that is roughly proportional to flow, i.e., they should be closer together toward mid-channel, where most of the flow travels, than toward the banks, where the proportion of total flow is smaller. The number of vertical composites required and the number of depths sampled for each are usually determined in the field by the sampling crew. This determination is based on a reasonable balance between two considerations: 1) the larger the number of subsamples, the more nearly the composite sample will represent the water body, and 2) taking any subsamples is time-consuming and expensive, and increases the chance of contamination.

In most circumstances, a number of sediment samples should be collected along a cross-section of a river or stream in order to adequately characterize the bed material. A common procedure is to sample at quarter points along the cross-section of the site selected. When the sampling technique or equipment requires that the samples be extruded or transferred at the site, they can be combined into a single composite sample. However, samples of dissimilar composition should not be combined but should be stored for separate analysis in the laboratory.

1.2.8.3 Lakes, Ponds, and Impoundments. Lakes, ponds, and impoundments have a much greater tendency to stratify than rivers and streams. The relative lack of mixing requires that more samples be obtained. Occasionally, an extreme turbidity difference may occur vertically where a highly turbid river enters a lake, and each layer of the stratified water column needs to be considered.

Since the stratification is caused by water temperature differences, the cooler, heavier river water is beneath the warmer lake water. A temperature profile of the water column as well as visual observation can detect the different layers and they can be sampled separately.

The number of water sampling sites on a lake, pond, or impoundment will vary with the size and shape of the basin. In ponds and small impoundments, a single vertical composite at the deepest point may be sufficient. Similarly, the measurement of DO, pH, temperature, etc., is to be conducted on each vertical composite aliquot. In naturally-formed ponds, the deepest point is usually near the center; in impoundments, the deepest point is usually near the dam.

In lakes and larger impoundments, several vertical subsamples should be composited to form a single sample. These verticals are often taken along a transect or grid. In some cases, it may be of interest to form separate composites of epilimnetic and hypolimnetic zones, but normally a composite shall consist of several vertical subsamples collected at various depths.

In lakes with irregular shape and with several bays and coves that are protected from the wind, additional separate composite samples may be needed to adequately represent water quality. Similarly, additional samples should be taken where discharges, tributaries, land use characteristics, and other such factors are suspected of influencing water quality.

When collecting sediment samples in lakes, ponds, and reservoirs, the site selected should be approximately at the center of water mass. This is particularly true for reservoirs that are formed by the impoundment of rivers or streams. Generally, the coarser grained sediments are deposited near the headwaters of the reservoir, and the bed sediments near the center of the water mass

will be composed of fine-grained materials. The shape, inflow pattern, bathymetry, and circulation must be considered when selecting sediment sampling sites in lakes or reservoirs.

1.2.8.4 Estuarine Waters. Estuarine areas are zones where inland freshwaters (both surface and ground) mix with oceanic saline waters. Estuaries are generally categorized into three types, dependent upon freshwater inflow and mixing properties.

- **Mixed estuary** - is characterized by an absence of vertical halocline - (gradual or no marked increase in salinity in the water column) and a gradual increase in salinity seaward. Typically this type of estuary is found in major freshwater sheetflow areas, featuring shallow depths.

- **Salt wedge estuary** - is characterized by a sharp vertical increase in salinity and channelized freshwater inflow into a deep estuary. In these estuaries, the vertical mixing forces cannot override the density differential between fresh and saline waters. In effect, a salt wedge tapering inland moves horizontally, back and forth, with the tidal phase.

- **Oceanic estuary** - is characterized by salinities approaching full strength oceanic waters. Seasonally, freshwater inflow is small with the preponderance of the fresh saline water mixing occurring near, or at, the vegetated shoreline.

A reconnaissance investigation should be conducted for each estuarine study unless prior knowledge of the estuarine type is available. The reconnaissance should focus upon the freshwater and oceanic water dynamics with respect to the study objective. In this regard, National Oceanic Atmospheric Administration tide

tables and USGS freshwater surface water flow records provide perspective to the estuary dynamics. The basic in-situ measurement tools for reconnaissance include: a boat, recording fathometer, salinometer, and dissolved oxygen meter. These instruments, coupled with the study objective or pollution source location, whether it is a point or nonpoint source problem, provide the focus for setting sampling locations. More often then not, preplanned sampling locations in estuarine areas are changed during the actual study period. Due to the dynamics of estuaries, initial sampling often reveals that the study objective could be better served by relocating, adding, or deleting sampling locations.

Sampling in estuarine areas is normally based upon the tidal phases, with samples collected on successive slack tides.

Estuarine sampling programs conducted by the Contractor shall include vertical salinity measurements at one to five-foot increments coupled with vertical DO and temperature profiles. A variety of water sampling devices are available, but in general, the Van Dorn (or similar type) horizontal sampler is employed.

Samples are normally collected at mid-depth in areas where the depths are less than 10 ft, unless the salinity profile indicates the presence of a halocline (salinity stratification). In that case, samples are collected from each stratum. Depending upon the study objective, when depths are greater than 10 ft, water samples may be collected at the one ft depth, mid-depth, and one-ft from the bottom.

In general, estuarine investigations are two phased, with study investigations conducted during wet and dry periods. Depending upon the freshwater inflow sources, estuarine water quality dynamics cannot normally be determined by a single season study.

1.2.8.5 Control Stations. In order to have a basis of comparison of water quality, the collection of samples from control stations is always necessary. A control station above the source of waste is fully as important as are stations below,and should be chosen with equal care to ensure representative results. At times it may be desirable to locate two or three stations above the waste inflow to establish the rate at which the unstable material is changing. The time of travel between the stations should be sufficient to permit accurate measurement of the change in the constituent under consideration.

1.2.9 Sediment/Soil Sampling

The objective of this section is to give general guidance for the collection of soil/sediment samples during field investigations.

1.2.9.1 Sampling Location/Site Selection. Areas selected for soil sampling shall be strategically located in order to collect a representative fraction of the soils with the minimum number of soils and effort. A surface inspection of the subject area shall be made to locate pertinent features such as rock outcrops, drainage patterns and surface runoff and to evaluate the relationship between these features and potential sources of pollution. The location of sediment depositional areas are good indicators of surface runoff direction. If the direction of surface runoff or drainage is difficult to detect, observation of new deposition or sediment movement following a rain may prove helpful in establishing this direction. The spreading or fanning out of the sediment body will indicate direction of flow.

In most instances, the first investigation of a site will be a reconnaissance type survey. Soil sampling in these instances generally will be confined to surface or near-surface soils and/or sediments using hand equipment. For screening purposes, sampling

of this type should be conducted in depositional areas on the periphery of the study area, primarily at the downstream or downgradient portion(s) of the area of interest; however, an upgradient location also should be selected for obtaining background and/or control samples. Investigators should be aware that sampling in depositional areas tends to bias the sampling toward elevated concentrations which is useful as a screening tool, but should not be construed as representative of the area conditions.

More in-depth investigations usually are conducted after a preliminary study or reconnaissance survey has been completed. Review of previous investigations will aid in selection of suitable sampling locations and these studies should be examined when the study plan for the more detailed study is prepared. The number of samples and the number of test pits and/or borings and the specific depth that samples are collected will vary according to the site conditions and the scope of the investigations.

1.2.10 Potential Source of Contamination Sampling

Sampling at known or suspected hazardous waste sites potentially involves sampling operations that are inherently dangerous to the personnel involved. Therefore, the procedures outlined in the site Health and Safety Plan will be observed during sampling operations at known or suspected hazardous waste sites.

Sampling operations conducted at landfills and hazardous waste sites include the collection of on-site samples from open and closed containers, waste piles, pits, ponds, lagoons, leachate streams, spillage of materials, contaminated soil, as well as sampling of ground water and soil. Samples collected on known or potential hazardous waste sites shall be considered "concentrated" samples unless field personnel have valid reasons to believe otherwise. These samples shall be handled as hazardous materials.

1.2.10.1 Sampling Location Selection. When selecting a sampling location at a landfill or hazardous waste site, the following should be determined: surface water flow (drainage pattern), discharge and recharge areas, direction of ground-water flow, topography, leachate flow, location of streams in relation to the subject area, vegetation, wells in the area, seeps, springs, wet areas, soil conditions, and general geology. All of these items are important in evaluating a site for sampling both soils and water, and have been discussed at length in the sections on water and soil sampling.

When a site is being screened for sampling, the most productive method of determining sampling locations is to walk the boundary of the site focusing attention on areas where surface runoff leaves the site. The site shall be checked for leachate flow or surface spills. Springs, seeps, ponds, and wet areas shall be examined to see if they display signs of leachate. Obvious signs of leachate in the water are discoloration and/or odor. The soil shall be inspected to see if it is discolored. Areas of excessive dead vegetation and/or dead animals are good indicators of a potential hazard. Nearby water bodies and wells downgradient form the site shall be located for sampling to check for off-site migration of contaminants. Where necessary, test holes can be bored with hand or power equipment to define the general direction of ground-water movement and subsurface stratigraphic conditions.

1.2.11 Waste Sampling

Waste sampling includes the collection of sludge samples from municipal and industrial wastewater treatment facilities; samples of liquid waste and sludge from pits, ponds, and lagoons; the collection of concentrated waste samples from open and closed containers such as drums, barrels, tank trucks, and storage tanks; and waste piles. Personnel will follow the procedures outlined in

the Health and Safety Plan (Section 8.2) when collecting waste samples that are potentially hazardous.

1.2.12 Air Monitoring

In order to fulfill requirements for conducting risk assessments and evaluating the existence and/or potential for off-site hazardous emissions, ambient air samples will be collected during the PSC investigations. Both upwind and downwind sampling will be performed at the perimeter of selected PSCs to characterize detected constituents.

2.0 SAMPLING LOCATIONS AND FREQUENCY

2.1 Existing and New Locations

Existing sample locations at each site will be identified as close as possible and combined with newly established sampling locations based on the site specific project objective. These locations will be described in the OU FSP and QAPjP. Locations to be sampled at each site for each matrix type will be referenced on figures and a table identifying the frequency and type (grab, composite, etc.) of samples collected will be presented in the OU FSP and QAPjP.

2.2 Regulatory Requirements to Achieve Sample Representativeness

For those PSCs undergoing sampling for purposes of achieving compliance with a regulatory standard, the statistical sampling protocols described in Chapter Nine, Volume II, of the document entitled "Test Methods for Evaluating Solid Waste", SW-846, Third Edition by EPA will be used. These statistical procedures provide a mathematical method for determining if sufficient samples have been collected to be representative of the matrix (soil, waste) being sampled. In addition, these procedures also provide a statistical method for demonstrating compliance with regulatory standards.

3.0 SAMPLE DESIGNATION

A sample identification system has been developed to enable the Contractor's field personnel to establish unique and appropriate identifications for each sample collected. This system incorporates identifiers for the PSC, sample matrix, and the sample location. The identification system has been designed to give reference to previously existing sample location identification numbers. The identification number will consist of a Site code, PSC code for both new and old PSC numbers, date code, sample matrix code, and sample number. Each of these codes is described below and also in the BFSP.

Site Code. The Site code for all samples will "J" for Naval Air Station, Jacksonville, Florida (NAS/Jax).

PSC Code. The PSC code is a location code. This code will be a number, eg. 25 for PSC No. 25.

Date Code. The date code will consist of a four digit number. The first two digits refer to the month and the last two digits refer to the year.

Sample Matrix Code. This code includes Field QC Samples. The sample matrix code will be a two letter (alpha) code that describes the type of sample matrix. The following codes will be used:

o	Soil:	SL
o	Sediment:	SD
o	Surface Water:	SW
o	Ground Water (Dug in pit, trench, etc.):	GW
o	Ground Water (Monitor Well):	MW
o	Potable Water:	PW
o	Ambient Air:	AA
o	Waste, Sludge, Landfills, waste piles:	SM

- o Field blank (Water): FB
- o Equipment Rinsate blank: EB
- o Trip Blank: TB
- o Background (Soil): BS
- o Background (surface water, upstream): BU
- o Background (ground water): BG
- o Replicate RP

Sample Number Code. The sample number code will be a three digit number starting with 001; and proceeding sequentially 002,003, etc. This allows for potentially 999 samples from any matrix, although unlikely to occur, at any PSC.

Sample Sequence Code. The sample sequence code will be a single digit letter starting with A and proceeding sequentially B, C, etc. The sample sequence code is used for samples collected at multiple depths at the same location. The sequence code will be assigned sequentially with depth. If only one depth is sampled during a sample event then the sample sequence number will not be used.

Examples.

The following numbers are provided as examples to illustrate how the sample coding will work for each matrix. Assume the samples were collected from PSC No. 25 or PSC 56. Samples were collected in October of 1990.

Soil Samples:

PSC 25: J26109SL005

Sediment Samples:

PSC 25: J251090SD012

Surface Water Samples:

PSC 56: J561090SW015

Ground Water Samples: (Dug)

PSC 25: J251090GW028

Monitor Well Ground Water Samples:

PSC 25: J251090MW152

Ambient Air Samples:

PSC 56: J561090AA023

Field QC Samples:

PSC 25: Field Blanks: J251090FB004

Equipment Blanks: J251090EB005

4.0 SAMPLING PROCEDURES

4.1 General Considerations

This section discusses the standard practices and procedures utilized by the Contractor during field operations to ensure the collection of representative samples. Sampling activities are conducted with the expectation that they will be used for regulatory purposes, unless specifically stated to the contrary in advance of the field investigation. Therefore, the use of proper sampling procedures cannot be over emphasized. The collection of representative samples depends upon:

(1) ensuring that the sample taken is representative of the material or medium being sampled;

(2) using proper sampling, sample handling, preservation, and quality control techniques;

(3) properly identifying the collected samples and documenting their collection in permanent field records;

(4) maintaining sample chain-of-custody; and

(5) protecting the collected samples by properly packing and transporting (shipping) them to a laboratory for analysis.

The objectives of this section are to present:

(1) general considerations that must be incorporated in all sampling operations;

(2) specific standard sampling site selection and collection procedures for an individual medium; and

(3) specific sampling quality assurance procedures as well as equipment calibration and maintenance requirements for sampling equipment.

The following factors and procedures shall be considered and implemented in planning and conducting sampling operations. These factors and procedures must be considered in view of specific objectives and scope of each individual field investigation.

4.1.1 Selection of Representative Sampling Sites

Representative sampling sites are dependent on the type of investigation undertaken and are discussed under type of sample procedures for each medium later in this section.

4.1.2 Selection and Proper Preparation of Sampling Equipment

The type of sampling equipment to be used is dictated by the investigation and is discussed for each medium later in this section. Attachment A describes the standard equipment cleaning procedures.

4.1.3 Sampling Equipment Construction Material

The material that sampling equipment is constructed of can affect sample analytical results. Materials used must not contaminate the sample being collected and must be readily cleaned so that samples are not cross-contaminated. The standard materials for sampling equipment used to collect samples for trace organic compounds or metals analyses are, in order of decreasing desirability: Teflon™, glass, stainless steel, and steel.

4.1.4 Selection of Parameters to be Measured

Parameters to be measured are usually dictated by the purpose of an investigation and should be based on required monitoring conditions of applicable regulations or on the contractor's knowledge of the problem being investigated. Parameters to be measured will be specified for each operable unit in their respective QAPjPs.

4.1.5 Dissolved and Particulate Sample Fractions

A water sample is generally composed of dissolved and particulate fractions. When it is necessary to analyze samples for each fraction, instead of the total sample, it may be necessary to filter the sample in the field. The standard procedure for using the field filtration apparatus is in Attachment C. Filtration of ground-water samples in Florida is prohibited [Chapter 17-730.900(2) Part II.M.10(a) of the Florida Administrative Code]. The Contractor may analyze filtered samples only for comparison with unfiltered samples.

4.1.6 Required Sample Volumes

The volume of sample obtained should be sufficient to perform required analyses with an additional amount collected to provide for quality control needs, split samples, or repeat examinations. Individual aliquots of a composite sample should be at least 100 milliliters in order to minimize sample solids bias when using a peristaltic pump.

The volume of sample required by contract laboratories depends on the analyses to be performed. Although Table 1 of the QAPP specifies the amount normally required, the laboratory receiving the sample should be consulted for specific volume requirements. The volumes of samples collected from waste sources at hazardous

waste sites or samples from sources which are known to be toxic should be kept to an absolute minimum.

The sample volume required for each analysis is the volume of the standard container less ullage (empty space) required for sample mixing by laboratory personnel and safe shipment of samples to the laboratory. The Contractor shall allow a minimum of ten percent ullage in every sample container for this purpose. The only exception is samples collected for purgeable organic analysis (VOC) or dissolved gases such as sulfides for which sample containers must be completely filled.

4.1.7 Selection and Proper Preparation of Sample Containers

The type of sample container is dictated by the analyses required. Standard sample containers to be used are presented in Table 1 of the QAPP.

4.1.8 Sample Preservation

Samples for some analyses must be preserved in order to maintain their integrity. Preservatives required for routine analyses of samples are given in Table 1 of the QAPP. All chemical preservatives used will be supplied by the contract laboratories. All samples should be preserved immediately upon collection in the field. The only samples that should not be preserved immediately in the field are the following:

(1) Samples collected within a hazardous waste site that are known or thought to be highly contaminated with toxic materials. Barrel, drum, closed container, spillage, or other source samples from hazardous waste sites are not to be preserved with any chemical. These samples may be preserved with ice, if necessary.

(2) Samples that have extremely low or high pH or samples that may generate potentially dangerous gases if they were preserved using the procedures given in Table 1 of the QAPP.

(3) Samples for metals analyses which are shipped by air shall not be preserved with nitric acid in excess of the amount specified in Table 1 of the QAPP.

(4) Samples for purgeable organic compounds (VOC) analyses which are shipped by air shall not be preserved with hydrochloric acid in excess of the amount specified in Table 1 of the QAPP.

All samples preserved with chemicals shall be clearly identified by indicating on the sample tag that the sample is preserved. If the samples were not preserved, field records shall indicate why.

4.1.9 Sample Holding Times

The elapsed time between sample collection and initiation of laboratory analyses must be within a prescribed time frame for each individual analysis to be performed. Sample holding times for all routine samples collected by the Contractor are shown in Table 1 of the QAPP.

4.1.10 Sample Handling and Mixing

Once a sample has been collected, it may have to be split into separate containers for different analyses. The best way to split liquid samples is to stir the sample contents continually with a clean pipette or precleaned Teflon™ rod and allow the contents to be alternately siphoned into respective sample containers using Teflon™ or PVC (Tygon™ type) tubing. Teflon™ must be used when

analyses for organic compounds or trace metals are to be conducted. Any device used for stirring, or tubing used for siphoning, must be cleaned in the same manner as other equipment.

A true split of soil, sediment, or sludge samples is almost impossible to accomplish under field conditions. The more moisture samples contain, the more difficult it is to split them. Procedures such as the one outlined in Section 4.3.2 should be used to obtain a homogeneous sample. Even when such procedures are followed, the sample should be considered a duplicate and not a split sample.

After collection, all samples should be handled as few times as possible. Field personnel should use extreme care to ensure that samples are not contaminated. If samples are placed in an ice chest, personnel should ensure that melted ice cannot cause sample containers to become submerged, as this may result in sample cross-contamination. Plastic bags, such as Ziplock™ bags, should be used when small sample containers (e.g., VOCs or bacterial samples) are placed in ice chests to prevent cross-contamination.

4.1.11 Special Precautions for Trace Contaminant Sampling

Some compounds can be detected in the parts per billion and/or parts-per-trillion range. Extreme care must be taken to prevent cross-contamination of these samples. The following precautions shall be taken when trace contaminants are of concern:

(1) A clean pair of new, disposable gloves will be worn each time a different location is sampled;

(2) Sample containers for source samples or samples suspected of containing high concentrations of contaminants shall be placed in separate plastic bags immediately after collecting, preserving, labeling, etc.;

(3) If possible, ambient samples and source samples should be collected by different field teams. If separate collection is not possible, all ambient samples shall be collected first and placed in separate ice chests or shipping containers. Samples of waste or highly contaminated samples shall never be placed in the same ice chest as environmental samples. It is good practice to enclose waste or highly contaminated samples in a plastic bag before placing them in ice chests. Ice chests or shipping containers for source samples or samples suspected to contain high concentrations of contaminants shall be lined with new, clean, plastic bags.

(4) If possible, one member of the field team should take the notes, fill out labels, etc., while the other member does the sampling.

(5) When sampling surface waters, the water sample should always be collected before the sediment sample is collected.

(6) Sample collection activities should proceed progressively from the least contaminated area to the most contaminated area (if this fact is known).

(7) Personnel should use equipment constructed of Teflon™, stainless steel, or glass that has been properly precleaned (Attachment A) for collecting samples for trace metals or organic compounds analyses. Teflon™ or glass is preferred for collecting samples where trace metals are of concern. Equipment constructed of plastic or PVC shall <u>not</u> be used to collect samples for trace organic compounds analyses.

4.1.12 Sample Identification

All samples will be fully documented, as outlined in the QAPP, in the field records, on the field sample chain-of-custody record, and on the sample label. The sample identification system is described in Section 3.0.

4.1.13 Procedures for Identifying Potentially Hazardous Samples

Any sample either known or thought to be hazardous should be so identified on both the sample label and the field sample chain-of-custody sheet. Information explaining the hazard, i.e., corrosive, flammable, poison, etc., also shall be listed.

4.1.14 Collection of Auxiliary Data

All auxiliary data such as flow measurements, photographs of sampling sites, meteorological conditions, and other observations shall be entered into field records when the auxiliary data are collected. Auxiliary data relative to a particular sampling location should be collected as close to the sample collection time as possible. Specific types of auxiliary data to collect for each medium sampled are discussed later in this section.

4.1.15 Time Records

All records of time shall be kept using local time in the 2400 hour time format and shall be recorded to the nearest five minutes.

4.1.16 Transporting and Shipping of Samples

Samples may be hand delivered to the laboratory or they may be shipped by common carrier. The Contractor personnel must be aware that certain samples are hazardous materials and, as such, are regulated by the U.S. Department of Transportation under the

Transportation Safety Act of 1974. These regulations are contained in Title 49, CFR, Parts 110-119. Routine sample shipping procedures are provided in Attachment B.

4.1.17 Sample Chain-of-Custody

The Contractor shall maintain sample chain-of-custody during all field investigations for all samples collected. The standard sample chain-of-custody procedures used by the Contractor are given in Section 5.0 of the QAPP.

4.2 Geophysical Studies

4.2.1 Procedures

It is beyond the scope of this document to outline the specific procedural details to be followed for each method. These will be included as attachments to the respective OU FSPs. The information presented here is general considerations that must be observed when conducting geophysical studies.

When screening a hazardous waste site for sampling, the use of geophysical equipment is a good method of determining sampling locations in areas where drilling would be time consuming and costly, or would create a dangerous situation. Geophysical equipment can be used to screen a site in a short period of time with fairly accurate results. All geophysical equipment used during a study shall be calibrated according to the manufacturer's calibration procedures included with each instrument. Information shall be recorded in a field book as to the date and times calibrated, team members, and a complete chronological description of what transpired during the study.

When selecting the geophysical method(s) best suited for a field study, certain site factors should be considered. They

include the type of soils, the depth of ground water, general ground surface conditions (wet, dry, frozen),large surface or subsurface ore bodies, depth to bedrock, type of topography, large surface metallic objects (building, tanks, pipes,etc.), power lines and underground cables, buried drums, and/or contaminant plumes. The methods available for the site investigations have been discussed earlier. Depending on site conditions and study objectives, one or more of these methods might be used in a hazardous waste site investigation.

As a general rule, the locations of geophysical abnormalities detected during a geophysical study should be documented using standard site mapping techniques.

4.2.2 Specific Geophysical Study Techniques

The following is a brief description of the methods that may be used.

4.2.2.1 Metal Detection. Metal detectors are used to detect changes in electrical conductivity caused by the presence of metallic materials, both ferrous and non-ferrous. Metal detectors: (1) are limited to shallow depths (0 to 8 feet), (2) can detect large metallic objectives such as buried drums and metallic laden wastes, (3) are light weight and economical, and (4) are insensitive to soil moisture and small metallic objects.

4.2.2.2 Magnetometry. Magnetometers are designed to detect and accurately measure changes in the earth's magnetic field. The major feature of the magnetometer is ease of operation and reliability.

The magnetometer's primary design function is detection of magnetic objects such as buried drums or large ore bodies which alter the earth's magnetic field. Magnetometers should not be

calibrated or used in or around buildings, near power lines, or directly on the ground.

The diurnal magnetic field drift is measured by either setting up a base station or using tie lines which cross the survey lines. If it is found that the diurnal changes are significant then a procedure is used to remove the earth's field drift from the data. While data is being taken in the field the operator will check that severe and rapid changes in the diurnal drift are not occurring by periodically remaining stationary while continuing to take readings. If severe changes are occurring the data acquisition will be stopped. Further checks on the station location surveying and the diurnal drift can be recognized by a trained interpreter from the contoured magnetic field data. One such feature is called the herringbone pattern which shows that a line of field stations is shifted in one direction relative to the other lines of field stations. The vertical gradient data also provides a significant measure of quality control since this data is not influenced by the diurnal changes in the magnetic field strength.

4.2.2.3 Electromagnetic Induction (EM). A transmitter induced coil directs induced current loops into the group, which produce secondary fields. These secondary fields are then sensed or detected by the receiver coil, amplified, and stored on a strip chart recorder or magtape, if desired.

EM instruments measure true soil conductivity in uniform, homogeneous subsurface conditions. EM units also measure apparent soil conductivity in layered soils.

Measurements can be obtained from depths as deep as 60 meters with these instruments. EM units are very effective for rapid site reconnaissance and detection of buried drums, pipes, and metallic type conductors. EM's are not limited by frozen ground, wet or dry soils.

Pre-survey instrument calibrations are performed according to the manufacturers specifications and the battery has to be checked daily. Care is required when taking readings to hold the instrument at the correct orientation. When near power lines the meter needle has to be carefully observed so as to recognize the influence of power lines. It is important when taking conductivity readings that the coarse scale switch is adjusted such that the meter records near the middle of its scale. If a data logger is used an observer's notebook is used to record the identification of each line so that the integrity of coordinate information is maintained.

4.2.2.4 Electromagnetic Soundings (Transient Soundings). Transient soundings are used to obtain depths and thicknesses of rock strata under the sounding site. The method is valid for depths from about 20 feet to several thousand feet and is particularly suited to locating thin conductive beds.

Pre-survey modeling is important in every geophysical method but is vital in Transient soundings. Such models enable the time on the sounding curve when the target will be observed to be ascertained and the power requirements of the transmitter in order to have data signals greater than the background noise at that time. In the field, care is required to maintain the receiver coil horizontal and to measure the background noise at the site. When taking data, care is also required to ensure that reliable signals are being recorded. This is often done by taking more than one data set and assessing the repeatability of the data. Interpretation is by computer inversion thereby assuring that the interpretation is consistent with the field data.

4.2.2.5 Resistivity Methods.

(a) Schlumberger Sounding. Distances to the electrodes need to be measured to an accuracy of about two

percent. Resistivities are calculated at the field site in order to check their reasonableness and plotted to ascertain that they produce a smooth sounding curve. Interpretation is consistent with the field data. One of the main difficulties with the method is the influence of lateral variations in resistivity. It is usual to conduct two soundings, with the line of electrodes being orthogonal, at some of the sounding locations in order to assess the influence of lateral variations in resistivity.

(b) Induced Polarization. Induced polarization measurements require an order of magnitude, more sensitivity of the equipment than resistivity measurements, and require certain precautions when collecting the data. The amount of precautions depends on the depth of investigation and the power of the transmitter. If long lengths of wire are used then cross-coupling between the wires becomes significant and is minimized by keeping the current and potential wires separated by a few feet. In some cases, usually in deeper surveys, electromagnetic inductive coupling is a problem and has to be recognized.

(c) Gravitational Methods. Gravity meters require great care when reading. The meter is always read from the same position and care is required not to disturb the ground near the meter, thereby tilting the meter slightly. The characteristics of the meter have to be carefully observed so as to identify possible sources of reading error such as a distant earthquake, which often cause slow oscillations of the meter. Tree root movement will

also be observed on the meter on windy days and has to be avoided. Reading locations near sudden topographic changes also are avoided if possible. The station elevations are surveyed for surveys where elevation changes are significant. Whether or not they are significant depends on the size of the anomaly expected.

(d) Ground Penetrating Radar (GPR). The equipment is set up in the field according to the manufacturers specifications. A preliminary test survey is performed to determine the scaling to be used for the display and printout. If a local culvert at a known depth is available, a traverse across this feature is conducted in order to calibrate the depth scale at the site.

(e) Electric and Nuclear Logging. Logging provides a record of the resistivities of the subsurface formations. Electric logging can only be performed in mud filled uncased bore holes. Nuclear logging can be performed in cased holes which precludes the use of electric logging techniques. Nuclear logging is also less sensitive to changes in water quality and is useful in locating clay formations which may be separated by sand formations containing salt or brackish water.

4.2.2.6 Specific Equipment Quality Control Procedures. All geophysical instruments used by the Contractor shall be calibrated in accordance with the manufacturer's specified calibration procedures, and shall only be calibrated by personnel that have been trained to do so. The calibration shall be checked periodically to ensure accurate readings. All calibration

procedures and pertinent information shall be documented in the field book.

Personnel using the geophysical equipment shall be trained in the use and maintenance of such equipment, and shall be able to interpret and present the gathered data in an easily understood manner in charts, graphs, maps, and formal reports. It is the responsibility of the Contractor to ensure that the personnel designated to use the geophysical equipment are qualified in the calibration and use of the equipment, and able to gather and interpret the data.

4.3 Types of Samples (Definitions)

The following definitions are applicable to the collection of soil sediments, sludge, waste, surface water, ground water and air samples. These definitions are provided to enable the user of the document to have a clear understanding of terminology. All definitions are consistent with the U.S. EPA.

4.3.1 Grab Sample

A grab sample is an individual sample collected over a period of time generally not exceeding 15 minutes. A grab sample is normally associated with water sampling. However, soil, sediment, liquid hazardous waste samples, etc., also may be considered grab samples; no particular time limit would apply for the collection of such samples.

1. Grab samples are:

    - Used to characterize the medium at a particular instant in time; and

- o Always associated with instantaneous waste flow data (where appropriate).

2. Grab sampling is conducted when:

   - o The water or wastewater stream is not continuous (e.g., batch-discharges or intermittent flow);
   - o The characteristics of the water or waste stream are known to be constant or nearly so;
   - o The sample is to be analyzed for parameters whose characteristics are likely to change significantly with time, i.e., dissolved gases, bacteria, etc.;
   - o The sample is to be collected for analysis of a parameter such as oil and grease where the compositing process could significantly affect the actual concentration; and
   - o Data on maximum/minimum concentrations are desired for a continuous water or wastewater stream.

3. Analyses for which samples for water shall always be collected on a grab basis or for which measurements shall be made in-situ include:

pH	phenol
temperature	oil and grease
dissolved oxygen	bacterial
sulfide	volatile organic compounds
chlorine residual	specific conductance
other dissolved gases	cyanide
dissolved constituents in field filtered samples (total-P, ortho-P, metals, etc.)	

4.3.2 Composite Sample

4.3.2.1 Timed Composite. A sample containing a minimum of eight equal volumes, discrete samples collected at equal time intervals over the compositing period. A timed composite may be collected continuously; they may be collected where water or wastewater flows vary widely and are not dampened by wastewater treatment units.

4.3.2.2 Flow Proportional Composite. A sample containing a minimum of eight discrete samples collected proportional to the flow rate over the compositing period. Flow proportional samples may be collected where water or wastewater flows vary widely and are not dampened by wastewater treatment units.

4.3.2.3 Times and Flow Proportional Composite Samples. The following guidance is given concerning the collection of composite samples:

1. Composite samples are:

   - o collected when average waste concentrations are of interest; and
   - o always associated with average flow data (where appropriate).

2. Composite sampling is used when:

   - o the water or wastewater stream is continuous;
   - o it is necessary to calculate mass/unit time loadings; or
   - o analytical capabilities are limited.

3. A timed composite shall be collected as follows:

   - o continuously; or
   - o constant sample volume with a constant time interval between samples;

4. A flow proportional composite shall be collected as follows:

   - o continuously, proportional to stream flow;
   - o with constant sample volume and the time between samples proportional to stream flow; or
   - o with a constant time interval between samples and the sample volume proportional to flow at time of sampling.

4.3.2.4 Areal Composite. A sample composited from individual grab samples collected on an areal or cross-sectional basis. Areal composites shall be made up of equal volumes of grab samples; each grab sample shall be collected in an identical manner. Examples include sediment composites made up of quarter-point grab samples from a stream, soil samples from grid points on a grid system, water samples collected at various depths at the same point or from quarter points in a stream, etc.

4.3.3 Split Sample (Referee Duplicate)

A sample which has been portioned into two or more containers from a single sample container. Portioning assumes adequate mixing to assure the "split samples" are, for all practical purposes, identical. See the QAPP for further information.

4.3.4 Duplicate Samples (Field Replicates)

Samples collected simultaneously from the same source under identical conditions into separate containers analyzed by the same laboratory. See QAPP for further information.

4.3.5 Reference or Control Sample

A sample collected upstream or upgradient from a source or site to isolate the effects of the source or site on the particular ambient medium being sampled.

4.3.6 Background Sample

A sample collected from an area, water body, or site similar to the one being studied, but located in an area known or thought to be free from pollutants of concern.

4.4 Specific Sample Collection Quality Control Procedures

This subsection provides guidelines for establishing quality control procedures for sampling activities. Specific guidelines for sample site selection, selection of sampling equipment, types of samples to be collected, standard sample collection procedures, specific maintenance and calibration procedures for sampling equipment, and other considerations are presented for each matrix later in this Section. Specific requirements for all sampling activities are presented in Sections 4.5 through 4.13. Strict adherence to all of the standard operating procedures outlined in this chapter form the basis for the sampling quality assurance program. Additional QA/QC procedures are specified in the BSAP-QAPP.

4.4.1 Traceability Requirements

All sample collection activities shall be traceable through field records to the person collecting the sample and to the specific piece of sampling equipment (where appropriate) used to collect that sample. All maintenance and calibration records for sampling equipment (where appropriate) shall be kept so that they are similarly traceable.

4.4.2 Quality Control

Field quality control samples are necessary to monitor both field and laboratory performance. They provide a means of checking the validity of the sample results. Field QC samples are described in the QAPP. These data will be periodically examined to determine if any problems are evident with specific types of media samples or with the procedures used by the contractor. The Quality Assurance Officer will advise the Project Manager of any problems encountered so that corrective action can be taken.

4.4.2.1 Measurement of Sample Handling Effectiveness. The effectiveness of sample handling techniques will be monitored by utilizing preserved and unpreserved field blank samples. These blank samples will be prepared by field personnel. Blanks, including trip blanks, equipment blanks, and field blanks will be prepared and analyzed as described in the QAPP.

(a) Equipment rinsate blanks are collected as a check on the efficiency of the cleaning procedures for the sampling equipment. A sampler rinsate is collected by placing laboratory-grade water in contact with the field sampling apparatus (bailer, pump tubing, etc.) after they have been cleaned. For example, a bailer used to sample ground water is cleaned in accordance with procedures listed in

Attachment A of the BFSP, then the bailer is filled with reagent grade deionized/organic-free or distilled water. This deionized water is then sealed in the same type of sample container as the other samples, preserved in the same manner, and analyzed for the parameters of interest. Sampler rinsates are collected at frequencies specified in the BSAP-QAPP.

(b) Field blanks are collected for all parameters of interest. A field blank is composed of the appropriate containers filled in the field with organic-free water and preserved in the same manner as the samples. It is analyzed along with the samples for the parameters of interest. Field blanks are collected at frequencies specified in the BSAP-QAPP.

(c) A trip blank is generally specific to VOC analysis and is required at the frequency of one per sample cooler. A trip blank is a vial filled in the laboratory with organic-free water that travels unopened with the sample bottles. These are submitted at frequencies specified in the BSAP-QAPP.

4.4.2.2 Measurement of Relative Sampling Precision. The following duplicate sampling procedures shall be used during the collection of samples as a relative measure of the precision of the sample collection process. Duplicate grab and composite samples shall be collected during all site investigations and studies at frequencies specified in the QAPP and QAPjP. No more than ten percent of all samples shall be collected in duplicate. These samples shall be collected at the same time, using the same procedures, the same equipment, and in the same types of containers

as the required samples. They shall also be preserved in the same manner and submitted for the same analyses as the required samples. The collection of duplicate composite samples shall require the installation of duplicate automatic sampler setups if automatic samplers are used for sample collection.

4.4.2.3 Measurement of Sample Container, Sample Equipment, and Cleaning Procedure Integrity. Specific quality control procedures are outlined in the BSAP-QAPP Section 4.0.

4.4.2.4 Special Quality Control Procedures for Water Samples for Extractable, Pesticide, or Herbicide Organic Compounds Analyses. The Contractor shall submit duplicate water samples for extractable organic, pesticide, and/or herbicide organic compounds analyses from one sampling location per project. This sample should be collected from a location expected to be relatively free from contamination, since this sample will be used for laboratory quality control purposes. The duplicate sample should be clearly identified as "Duplicate Sample for Matrix Spike" on the sample label, chain-of-custody record, and on the field logbook.

4.5 Ground-Water Sampling

4.5.1 Sampling Preparation

Prior to the sampling event, the field personnel should be adequately prepared. The following items should be included for the field sampling:

1) Site map, names of contacts, and access keys

2) Water sampling logs, chain-of-custody forms, sample labels, waterproof-ink pen, and tape

3) Sample containers (check for proper number, type, and preservatives), coolers, and ice

4) Cooler custody seals

5) Water-level measurement equipment

6) Well purging equipment

7) Water sampling equipment (single sample disposable polyethylene and Teflon™ bailers)

8) Field analysis (pH, temperature, specific conductivity) instruments and standards

9) Teflon™-coated cord or wire or disposable nylon rope, knife, and miscellaneous tools

10) Gloves and towels

11) Laboratory grade detergent and deionized water

12) 5-gallon bucket

13) Power sources for pumps; i.e., portable generator

14) Filtering equipment for dissolved metals

15) Distilled or deionized, organic free water

16) Aluminum foil

17) Plastic sheeting (ground cover)

All equipment must be checked for proper operation. Equipment that will come in contact with the ground water must be properly cleaned before use (see Attachment A).

Arrange for site access prior to leaving for the sample location. Upon arriving at the site, the field personnel should inform appropriate people of their presence and the approximate time they will be at the site. Field personnel can be apprised of any changes at the site of which the project manager was unaware.

4.5.2 Well Preparation

Upon arriving at the well, check the well for any above-ground damage and the grout for structural integrity. Unlock and remove the well cap (a wrench may be required) and allow the well water level to come to equilibrium with the atmosphere. New plastic sheeting should be placed around the well, even where a concrete slab is in place to prevent possible equipment contamination. Clean the top of the well casing prior to purging and sampling. Preliminary information can be recorded on the well sampling log at this time.

4.5.2.1 Ground-Water Level, Total Sounded Depth, and Free-Product Level Measurements. Procedures for measuring water level and free product elevations are described in the following two sections.

(a) Ground-Water Level and Total Sounded Depth Measurements. The static water level and the total sounded depth of the well should be measured prior to purging and sampling well water. An electronic water-level indicator (M-scope) may be used for the water-level measurement if free product is absent on the interface probe. Measurements should be

referenced to the survey point (top of well casing).

Whether or not the well has been surveyed, total depth of the well will have to be measured from top of casing and be recorded. This datum can be used to confirm that the proper well has been identified, if the construction specifications are available, the well has not filled with silt, and if the volume of standing well water can be accurately calculated. Record the measurements on the water sampling log. Prior to measuring another well, wash the tape with a detergent solution and then rinse with deionized water.

(b) Free-Product Level Measurements. Determining the thickness of free-product is accomplished by two separate measurements: depth-to-water and depth-to-free-product, the difference between the two being the free-product thickness. The measurements are to be made with an electronic interface probe. The water level will be determined, when free-product is present, by submerging the probe well below the water/free-product interface and then determining the location of the interface by passing from water to free-product.

The correction for free-product levels, made in order to establish the potentiometric water surface, is to be performed in the office. Water-table elevations should be calculated to account for the depression of the water surface caused by the mass of free-product floating on the surface. The formula for this determination is:

$$TOC - (DTW - [0.85 \times PT])$$

where TOC equals the elevation of the top of casing, DTW equals the depth to water, and PT equals the measured product thickness.

Record the measurements on the well sampling log. Note: No ground water sample shall be collected if free-product is detected.

4.5.2.2 Purging the Well (General Procedure). After a water-level measurement has been taken, the well should be purged to remove the standing water. If a pump is used, be sure the pump intake is at the top of the water column. As the water level drops, the pump or suction tube intake should be lowered so that the water in the well casing is completely and efficiently removed. The tube should be removed before suction has been discontinued. Bailing the well is acceptable; however, if a bailer is employed, use extreme care in lowering the bailer into the well to avoid "surging" the water in the casing, which could disturb the formation deposits (i.e., sand) at the bottom of the well. More information on purging techniques and equipment is presented in subsequent sections.

Three to five times the calculated standing well water volume is removed from the well when purging. The volume of well water (in gallons) is calculated using the following equation:

$$v = 7.48\ \pi\ r^2\ h$$

where, v = volume of standing water (gallons)
r = radius of well casing (ft)
h = height of standing water (ft)

Wells that recharge slowly (those not filled back to the static level within eight hours), should be purged completely at least once and then sampled after the water level has recovered approximately 75 percent. The rate of recharge for all wells should be recorded for each sampling interval.

Deciding when the required volume of water has been purged from the well can be determined by directly measuring the amount discharged into a container of known volume or by measuring the

time of pumping with a calibrated pump. Flow measurement is preferred for submerged pumps inasmuch as pumping rates are a function of head. A purge pump (peristaltic or submersible) may be calibrated (i.e., the pumping rate may be determined) by measuring the time required to fill a container of known volume. Once the required volume to be purged and the pumping rate are known, the time necessary to pump the required amount may be calculated by the formula:

$$T = \frac{V}{R}$$

where, T = time (minutes)
V = volume of standing water (gallons)
R = rate of flow (gallons/minute)

Field water sample logs or record sheets should have a table of well bore volumes per linear foot for various well sizes to allow calculation of well volumes in the field.

This method shall be used only with pumps with a constant pump rate, such as gasoline powered or electric submersible pumps. It should not be used with battery powered pumps. As the batteries lose their charge, the pump rate decreases so that pumping time calculations using initial, high pump rates are erroneously short.

(a) Purging Equipment and Techniques. Monitoring well purging is accomplished by using in-place plumbing/pumps or when in-place pumps are not available, by using either a peristaltic, turbine, bladder, centrifugal, or other appropriate pump, depending on well depth. A Teflon™, closed top bailer may be used for purging; however, bailing stirs up sediment in the well and tends to increase turbidity; thus pumping is preferred.

Other monitoring equipment used during purging includes water level indicators, pH meters, thermometers, and conductivity bridges. (See Section 6.0, Field Analytical Procedures)

(b) Purging Techniques (Wells Without Plumbing or In Place Pumps). For permanently installed wells, the depth of water shall be determined (if possible) before purging. This can be accomplished by attaching a weight on the end of a tape and lowering it into the well until it touches the water, or by use of a mechanical or electrical water level indicator (see Ground-water Level Measurement Techniques, Section 4.13.5). Field personnel should exercise extreme caution during this procedure to prevent contamination of the well. This is a critical concern when samples for trace organic compounds or metals analyses are collected.

Using pumps to purge - When suction lift or centrifugal pumps are used, only the intake line is placed into the water column. To minimize contamination, the line placed into the water is either standard cleaned, Teflon™, in the case of the suction lift pumps, or standard cleaned stainless steel pipe attached to a hose, when centrifugal pumps are used.

When submersible pumps (bladder, turbine, displacement, etc.) are used, the pump itself is lowered into the water column.

Using bailers to purge - Standard cleaned, Teflon™ bailers with new nylon rope monofilament line or cleaned Teflon™ coated stainless steel wire are lowered into top of the water column, allowed to fill, removed and the water is discarded.

Field care of purging equipment - Regardless of which method is used for purging, new aluminum foil or plastic sheeting shall be placed on the ground surface around the well casing to prevent contamination of the pumps, hoses, ropes, etc., in the event they need to be placed on the ground during the purging or accidentally come into contact with the ground surface.

It is preferable that hoses used in purging that come into contact with the ground water be kept on a spool, both during transporting and during field use, to further minimize contamination from the transporting vehicle or ground surface.

Purging entire water column - The pump/hose assembly or bailer used in purging should be lowered into the top of the standing water column and not deep into the column. This is done so that the purging will "pull" water from the formation into the screened area of the well and up through the casing so that the entire static volume can be removed. If the pump was placed deep into the water column, the water above the pump may not be removed, and the subsequent samples collected may not be representative of the ground water.

To minimize cross contamination between wells, no more than three to five feet of hose should be lowered into the water column. If the recovery of the well is at least as fast as the pump rate, the pump may be left hanging at the initial level until an adequate volume has been purged. If the pump rate exceeds the recovery rate of the well, the pump will have to be lowered, as needed, to accommodate the drawdown.

After the pump is removed from the well, all wetted portions of the hose and the pump shall be cleaned as outlined in Attachment A.

Careful consideration shall be given to using pumps to purge wells which are excessively contaminated with oily compounds, because it may be difficult to adequately decontaminate severely contaminated pumps under field conditions. When wells such as this are encountered, alternative purging methods, such as bailers, should be considered.

(c) Purging Techniques - Wells With In-Place Plumbing. In-place plumbing is found at water treatment plants, industrial water supply wells, private residences, etc. The objective of purging is the same as with monitoring wells without in-place pumps; to ultimately collect a sample representative of the ground water.

The volume to be purged depends on several factors: whether the pumps are running continuously or intermittently, how close to the source the sample can be collected, and the presence of any storage/pressure tanks between the sampling point and the pump. If storage/pressure tanks are present, an adequate volume must be purged to totally exchange the volume of water in the tank.

(1) Continuously running pumps. If the pump runs continuously, and the sample can be collected prior to a storage/pressure tank, no purge, other than opening a valve and allowing it to flush for a few minutes, is necessary.

If the pump runs continuously, and a storage/pressure tank is located ahead of the sample location, the purge must include the entire storage volume to be sure that a sample representative of the ground water will be collected.

(2) Intermittently running pumps. If the pump runs intermittently, it is necessary to determine the volume to be purged, including storage/pressure tanks that are located

ahead of the sampling location. The pump should then be run continuously until the required volume has been purged.

4.5.3 Sampling the Well

4.5.3.1 Field Measurements. After pumping the well, a water sample should be collected to obtain measurements of pH, temperature, and specific conductivity. Before obtaining these measurements, the field instrumentation must be properly calibrated with reference standards in accordance with the manufacturer's recommendations and procedures specified in Section 5.4. After calibration take the sample reading and record the values in the field water sampling log.

4.5.4 Sampling Equipment and Techniques - Ground Water

4.5.4.1 Equipment. Sampling equipment to be used by the Contractor will include Teflon™ bailers, peristaltic pumps, and submersible pumps as appropriate.

4.5.4.2 Sampling Techniques - Wells with In-place Plumbing. Samples should be collected following purging from a valve or cold water tap as near to the well as possible. Samples should be collected directly into the appropriate containers referenced in Table 1 of the QAPP.

4.5.4.3 Sample Collection - Wells Without Plumbing. Following purging and after obtaining the field measurements, the well should be sampled for the parameters of interest. Sampling should be completed within 2.0 hours of purging the well. Care should be exercised when selecting sampling equipment to ensure that the materials that make up the equipment are compatible with the sample parameters and also comply with state and federal regulatory requirements for sampling. Generally speaking, Teflon™ is preferred but stainless steel, polyethylene, or PVC may be

acceptable. Teflon™ is universally accepted by the U.S. Environmental Protection Agency (EPA).

Various types of equipment are available for sample collection, the most commonly used being bailers (Teflon™, steel, or single sample, disposable polyethylene), submersible pumps, peristaltic pumps, and selected bladder pumps (provided there is no air contact with sample). Bottom-entry bailers will be employed to collect organic parameters and Teflon™-coated stainless steel, disposable cables of nylon or large-diameter monofilament fishing line should preferably be used to lower the bailer into the well. If a stainless steel or Teflon™-coated cable is used instead of a disposable cable, the cable should be cleaned between each use. When bailing, new foil or plastic sheeting should be placed on the ground around each well to prevent contamination of sampling equipment in the event any equipment is dropped or otherwise comes in contact with the ground.

Stainless steel submersible pumps are readily available. Slow discharge rates will be set on the pump to avoid surging the well. However, because these pumps may aerate the sample, they are not acceptable for collecting volatile and semi-volatile organic constituents.

A peristaltic pump fitted with Teflon™ drop line is ideal for collecting inorganic ground-water samples but is not acceptable for volatile and semi-volatile organic constituents. The equipment is relatively inexpensive and when fitted properly the sample water will not come in contact with the pump. Some manufacturers offer variable-speed peristaltic pumps which facilitate slowing the discharge rate when conducting in-line filtering.

Bladder pumps work by forcing an inert gas into a submerged bag or "bladder." As the bladder expands, ground water between the bladder and pump chamber is driven to the surface. Only bladder

pumps made of Teflon™ may be used for collecting both inorganic and organic constituents. Regardless of the parameter of interest, the gas used to drive the bladder pump cannot come in contact with the sample. If pumps are to be used for sample collection, intake and output hoses must be either cleaned or replaced between each use.

Once ground water to be sampled is brought to land surface, the water must be placed immediately in the appropriate container; the appropriate container is determined by knowing the parameters to be analyzed. Table 1 of the BSAP-QAPP lists appropriate containers and recommended sample volumes for selected parameters. Bottle caps should not be removed until the bottle is to be filled.

When sampling for volatile organic compounds (VOCs), extreme care must be taken in order to keep aeration of the sample to a minimum. This is achieved by pouring the sample down the inner-side of the container until the vial is full and the water is mounding. Never remove the Teflon™ lining from the cap used to seal the bottle because any natural oil from the skin that adheres to the liner might be detected in the laboratory analysis. After filling, invert the vial and tap the container to be sure there are no bubbles. If there are bubbles, remove the cap, fill it, and repeat the procedure. If bubbles persist, the vial may be defective. Bottles to hold ground water for inorganic analyses do not have to be dealt with in the same way, but can simply be filled to about 90 percent capacity and sealed.

When samples require preservation, take care not to overfill the pre-preserved container. If the container needs to be preserved, use the appropriate preservative as listed in Table 1 of the BSAP-QAPP and adjust to the correct pH if a preservative has not already been added by the laboratory.

If the inorganic sample is to be filtered, the filtration should be done immediately. Where possible, the procedure should

use an in-line flow-through filter. Water samples for dissolved metals analyses must be filtered through a 0.45-micrometer filter; fiber filters are not acceptable.

When bottle filling is complete, identify each sample container with a properly completed label. Labels should be filled out completely with data, time, sample ID, matrix, parameters to be analyzed, method number, preservative added, an the sampler's initials. The labels should be affixed to the containers prior to sampling. Place paired VOC vials for each sample in two Ziplock bags (one bag inside the other) to avoid cross-contamination and place the sample container in a cooler previously packed with ice. Water samples are not to be obtained from monitor wells that contain or that have contained free-product.

4.5.4.4 Special Sample Collection Procedures - Trace Organic Compounds and Metals. Special sample handling procedures shall be instituted when trace contaminant samples are being collected. All sampling equipment including pumps, bailers, drilling equipment, water-level measurement equipment, etc., which come into contact with the water in the well must be cleaned in accordance with the cleaning procedures described in Attachment A. Synthetic drilling mud (i.e., Revert™) should not be used when constructing wells which will be used for trace contaminant sampling. Pumps shall not be used for sampling, unless the interior and exterior portions of the pump and discharge hoses can be thoroughly cleaned. Blanks should be collected to determine the adequacy of cleaning prior to collection of any sample using a pump. Peristaltic pumps using Teflon™ tubing and a Teflon™ insert can be used to collect samples without the sample coming into contact with the pump. This is accomplished by placing the Teflon™ insert into the opening at a standard cleaned gallon glass container. The Teflon™ tubing connects the container, thereby drawing the sample into the container without coming into contact with the pump tubing.

Samples for purgeable organic compounds analyses shall be collected with bailers.

4.5.4.5 Specific Sampling Equipment Quality Assurance. All equipment used to collect ground-water samples shall be cleaned as outlined in Attachment A and repaired, if necessary, before being sorted at the conclusion of field studies. All equipment shall be tested before being issued for field studies. Cleaning procedures conducted in the field or field repairs shall be thoroughly documented in field records.

4.5.4.6 Auxiliary Data Collection. Water-table measurements from the top of the well casings (referenced to National Geodetic Vertical Datum) in permanent wells, and ground surface elevation in monitor wells should be made to determine the general direction of ground-water flow and gradient. The methodology to be used to determine well water levels are given later under Field Physical Measurements section of this manual. Tracer dyes, radioactive, and thermal detection methods can be used to determine direction and velocities of flow. Also, a study of the general topography and drainage patterns will generally indicate direction of ground-water flow.

Water table measurements shall not be taken until the water table has stabilized, preferably 48 hours after well installation for permanent wells. The ground surface elevation at the wells should be determined by standard engineering survey practices as outlined in the section on Field Physical Measurements.

In addition to water level measurements, the pumping rate used to purge a well, the volume of water in wells, and drillers logs are examples of auxiliary data that should be collected during ground-water sampling activities. This information should be documented in field records. Methodology for obtaining these data are given in the following sections.

Temperature, specific conductance, and pH shall be measured each time a well is sampled. This information is generally obtained during the purging process to evaluate the adequacy of the purging procedure. In this situation, the final measurements for these parameters prior to sampling shall be considered the measurement of record for the well. If these parameters were not evaluated during purging, they shall be obtained prior to sampling. Methodology for obtaining these data are given in the section on Field Analytical Measurements.

4.5.4.7 Sampling of Potable Water Supplies. When sampling potable water supplies, utmost care must be taken to ensure that samples are representative of the water supply being sampled. This is important not only from a technical and public health perspective, but also from a public relations standpoint. Poor sampling techniques may result in incorrect results (either not detecting a compound which is present or by contaminating the sample and falsely indicating a compound which is not present). If incorrect results are disclosed to the public, it may be impossible to change public opinion when correct results are reported.

(a) Sampling Site Selection/Sampling Techniques. Even though the same care and techniques used in wastewater, ground-water, etc., sampling (including thorough documentation of location, date, time, etc.) are used in potable water supply sampling, there are certain additional special procedures which shall be used.

When water samples are collected from wells, either by mechanical or hand pumping, the wells must be purged before the sample is collected. This procedure ensures that water in the formation is sampled, not the standing water in the pump or holding tank. As a rule of thumb, at least one volume of water in the well casing and storage tank should be evacuated (a 15-minute period is

usually sufficient for residential wells). This also ensures that contaminants that might have entered the area of the tap from external sources are flushed away.

Potable water samples shall be representative of the water quality within a given segment of the distribution network. Taps selected for sample collection should be supplied with water from a service pipe connected directly to a water main in the segment of interest and should not be separated from the segment of interest by a storage tank. The sampling tap must be protected from exterior contamination associated with being too close to the sink bottom or to the ground. Contaminated water or soil from the faucet exterior may enter the bottle during the collecting procedure since it is difficult to place a bottle under a low tap without grazing the neck interior against the outside faucet surface. Leaking taps that allow water to flow out from around the stem of the valve handle and down the outside of the faucet, or taps in which water tends to run up on the outside of the lip, are to be avoided as sampling locations. Aerator, strainer, and hose attachments on the tap must be removed before sampling. These devices can harbor a bacterial population if they are not cleaned routinely or replaced when worn or cracked. Whenever a steady stream of water cannot be obtained from taps, after such devices are removed, a more suitable tap shall be sought. Taps where the water flow is not steady should be avoided because temporary fluctuation in line pressure may cause sheets of microbial growth that are lodged in some pipe section or faucet connection to break loose. The cold water tap should be opened for two or three minutes or for sufficient time to permit clearing the service line; a smooth-flowing water stream at moderate pressure without splashing should be obtained. Then, without changing the water flow which could dislodge some particles in the faucet, the samples can be collected.

Regardless of the type of sample bottle being used, the bottle cap should not be placed on the ground or in a pocket. Instead, hold the bottle in one hand and the cap in the other, keeping the bottle cap right side up (threads down) and using care not to touch the inside of the cap. Exercise care not to lose the Teflon™ liner in certain bottle caps. Avoid contaminating the sample bottle with fingers or permitting the faucet to touch the inside of the bottle. When sampling for bacterial content, the bottle should not be rinsed before use. This may not only contaminate the bottle but also remove the thiosulfate dechlorinating agent (if used). When filling any container, care should be taken so splashing drops of water from the ground or sink do not enter into either the bottle or cap. In order to avoid dislodging particles in the pipe or valve, do not adjust the stream flow while sampling.

When sampling at a water treatment plant, samples should be collected both from the raw water supply and after chlorination.

Duplicate samples will always be collected for VOC and bacterial analyses. Single samples may be collected for extractable organic compounds, metals, phenol, cyanide, and conventional parameter analyses. The procedures given for Special Precautions for Trace Contamination Sampling (Section 4.1.11 and Section 4.5.4.4) shall always be followed when potable water supplies are sampled.

The contractor shall always obtain the name(s) of the resident or water supply owner/operator and the resident's exact mailing address, as well as the resident's home and work telephone numbers. The information is required so that the residents or water supply owner/operators can be informed of the results of the sampling program.

4.5.4.8 Ground-Water Sampling Probe Survey. Sampling probe surveys may also be conducted at the PSCs as determined appropriate

to determine the extent of the dissolved compound plume. The surveys will be conducted using a ground-water sampling probe for sample collection and a HNU Model 321 gas chromatograph (GC) for sample analysis. Details of GC operations are found in Attachment G of the QAPP. The samples typically are analyzed for volatile organic compounds. The results of theses surveys will enable monitor wells to be placed in locations necessary to define the contaminant plume boundaries. The number of sampling points, and their locations and depths will be discussed in the OU FSPs and QAPjPs. A description of the instrumentation, list of analyses and their respective detection limits, analytical methods and procedures (including instrument calibration and quality control practices) are covered in the QAPP.

A typical probe as shown in Figure 1 is constructed of stainless steel outer and inner tubes. The outer tube has a 2-inch outer diameter and is 3 ft in length with a conical point on the bottom. A top cap with a Teflon™ seal is attached to the outer tube to receive the inner tube. The inner tube is slotted to function as a screen and is connected to the drilling rods by an adapter that seals water from the outer ground-water collection tube. A flange is located on the bottom of the inner tube. The ground-water probe is advanced to the required depth by a direct push of a hydraulic ram. When the probe reaches the appropriate depth, the drilling rods are pulled back, causing the inner tube to come out of the outer tube. Formation water enters the slotted tube and is collected in the outer collection tube. After collection of the ground-water sample (approximately 10 minutes), the drilling rods are pulled back further, which causes a flange to isolate the water in the outer tube. The probe is then pulled to the surface. The outer tube can collect up to one liter of ground water, which is more than enough sample (40 mL) for analysis by the gas chromatograph. If additional ground water is necessary,

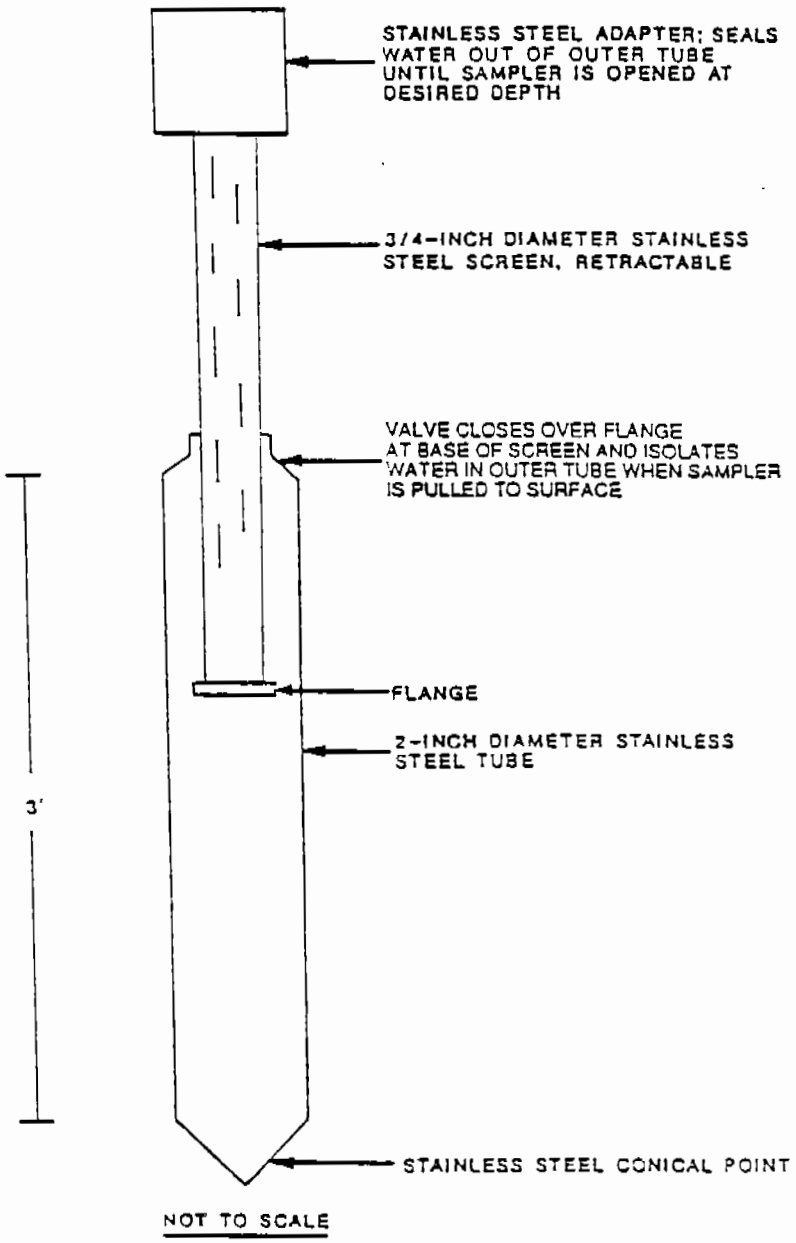

Figure: 1

Ground-water Sampling Probe

BASIC FIELD SAMPLING PLAN

NAS JACKSONVILLE
SEPTEMBER 1991

the probe will be decontaminated and the process repeated. At locations where ground-water sample points are to be taken beneath concrete, a four-inch coring device will be used to drill through the concrete prior to using the probe. After the sample is taken, a grout seal will be placed flush with the concrete surface and marked for future surveying.

The hole formed by the ground-water sampling probe location will be abandoned by grouting the hole to the surface using the tremie method.

Decontamination of the ground-water sampling probe is described in Attachment A. The probe is completely disassembled. Each piece is steam cleaned, rinsed with laboratory grade isopropyl alcohol, and finally rinsed with deionized water. The pieces are allowed to dry and then reassembled. In addition, the drilling rods will be steam cleaned.

4.6 Surface Water Sampling

4.6.1 Sampling Equipment and Techniques

Any equipment or sampling techniques used to collect a sample are acceptable as long as they do not cause the integrity of the sample to be violated and they do provide a sample which is representative of the stream being sampled.

4.6.1.1 Water Sampling Equipment/Techniques. The physical location of the investigator when collecting a sample may dictate the equipment to be used. If surface water samples are required, direct dipping of the sample container into the stream is desirable. This is possible, however, only from a small boat, a pier, etc., or by wading in the stream. Wading, however, may cause bottom deposits to rise and bias the sample. Wading is acceptable if the stream has a noticeable current (is not impounded), and the

samples are collected directly into the bottle while pointed upstream. If the stream is too deep to wade or if the sample must be collected from more than one water depth or from a bridge, etc., supplemental sampling equipment must be used.

Teflon™ bailers may be used for surface water sampling, if the data requirements do not necessitate a sample from a strictly discrete interval of the water column. A closed top bailer with a bottom check valve is sufficient for many studies. As the bailer is lowered through the water column, water is continually displaced through the bailer until the desired depth is reached, at which point the bailer is retrieved. This technique may not be successful where strong currents are found, or where a discrete sample at a specific depth is required.

If samples are desired at a specific depth, and the parameters to be measured do not require a Teflon™ coated sampler, a standard Kemmerer or Van Dorn sampler may be used. The Kemmerer sampler is a brass cylinder with rubber stoppers that leave the ends open while being lowered in a vertical position to allow free passage of water through the cylinder. The Van Dorn sampler is plastic and is lowered in a horizontal position. In each case, a messenger is sent down the rope when the sampler is at the designated depth, to cause the stoppers to close the cylinder, which is then raised. Water is removed through a valve to fill respective sample bottles. With a rubber tube attached to the valve, DO sample bottles can be properly filled by allowing an overflow. With multiple depth samples, care should be taken not to stir up the bottom sediment and thus bias the sample.

A plastic bucket can be used to collect samples if the parameters to be analyzed do not preclude it. However, the bucket should be rinsed twice with the sample water prior to collection of the sample. Also, an acid rinsed plastic bucket can be used to collect samples for trace metals analyses and a solvent rinsed

stainless steel bucket can be used to collect samples for trace organic compounds analyses.

4.6.2 Special Sample Collection Techniques

4.6.2.1 Trace Organic Compounds and Metals. Since trace organic compounds and metals are usually found in extremely low concentrations in ambient waters, the possibility of contamination is greater than with sediment or fish. Precautions must be taken with sampling equipment and preservatives to ensure that contamination does not occur.

Direct dipping of the sample containers is the preferred method of collecting surface water sample for trace levels pollutants analyses. If samples are to be split for enforcement or quality control purposes, and duplicate samples will not suffice, a sufficient volume for all sample containers should be collected in a large glass compositing container and then, with mixing, be alternately siphoned or poured into the respective sample bottles. This technique is not to be used for samples collected for purgeable organic compounds analysis.

4.6.2.2 Purgeable Organic Compounds Analyses (VOC). Water samples to be analyzed for purgeable organic compounds should be stored in 40-mL septum vials with screw cap and Teflon™-silicone disk in the cap to prevent contamination of the sample by the cap. The disks should be placed in the caps (Teflon™ side to be in contact with the sample) in the laboratory prior to the beginning of the sampling program.

The vials (40 mL) should be completely filled to prevent volatilization, and extreme caution should be exercised when filling a vial to avoid any turbulence which could also produce volatilization. The sample should be carefully poured down the side of the vial to minimize turbulence. As a rule, it is best to

gently pour the last few drops into the vial so that surface tensions holds the water in a sort of "convex meniscus." The cap is then applied and some overflow is lost, but air space in the bottle is eliminated. After capping, turn the bottle over and tap it to check for bubbles; if any are present, repeat the procedure. Since the VOC vials are pre-preserved, extreme caution should be exercised when the vials are used as the collection device for surface samples in order to prevent the loss of the preservative. The best procedure is to not completely fill the vial and to use the vial cap to collect enough water to top-off the sample. When collecting water samples for purgeable organic compounds, duplicate samples should always be collected from each location.

4.7 Soil Sampling

4.7.1 Equipment

The following equipment may be used for soil/sediment sampling: stainless steel spoons; stainless steel hand augers; stainless steel shovels; Shelby tubes; portable power augers (Little Beaver®); stainless steel scoops; glass pans; and drill rigs and associated equipment (i.e., split spoon samplers) which may on occasion be rented or borrowed for special projects.

4.7.2 Sampling Techniques

Sampling is often conducted in areas where a vegetative turf has been established. In these cases a clean stainless steel shovel should be used to carefully remove the turf so that it may be replaced at the conclusion of sampling. When the soil sample is obtained, it should be deposited into a glass bowl for mixing (or compositing, if applicable) prior to filling the sample containers. Mixing of the soil/sediment samples for chemical analysis should be performed in accordance with the procedures outlined in Section

4.8.1. If an undisturbed sample is needed, the Shelby tube sampler may be used.

If practical, and at the project leader's discretion, all trenches or holes that were excavated for sampling should be filled in and the turf replaced.

4.7.2.1 Surface Soil Sampling. Prior to sampling, leaves, grass, and surface debris should be removed from the area to be sampled using a clean stainless steel spoon or shovel. Surface soil samples shall then be collected using a precleaned, stainless steel scoop or spoon.

4.7.2.2 Shallow Subsurface Soil Sampling. Shallow subsurface soil samples may be collected by digging a hole or trench with a stainless steel shovel, then removing all of the loose soil and collecting a sample at the desired depth using a stainless steel spoon, a stainless steel hand auger, or a Shelby tube.

The stainless steel hand auger consists of three basic parts: (1) the bucket, (2) extension, and (3) handle. At the bottom end of the bucket are two cutting edges. The extensions are three feet long. When sampling deeper subsurface soil, a number of extensions may be joined end to end to increase the depth from which soil may be sampled.

The Shelby tube is a stainless steel tube approximately 12 inches long and 2 inches in diameter. One end of the tube has the edges beveled into a cutting edge. The other end can be mounted on an adapter which allows attachment to the end of the hand auger. The Shelby tube is pushed into the soil to be sampled and then removed. The tube can then be removed from the adapter and the soil pushed out using a decontaminated piece of equipment such as the handle of a stainless steel spoon. If an undisturbed sample is

required, the Shelby tube with its sample intact may be shipped directly to the laboratory for analyses.

4.7.2.3 Deeper Subsurface Soil Sampling. For deeper sampling using hand equipment, a stainless steel auger is used to bore a sampling hole until the desired depth is reached. Another clean auger bucket or a Shelby tube is then used to collect the sample which is placed in a glass bowl. Surface debris should be removed from the location of the sampling hole using a clean, stainless steel shovel or spoon before augering operations are initiated.

Often the depth which can be reached using a hand auger is limited due to the soil having low cohesion which leads to the hole collapsing or to the soil being very tightly packed which can make turning and removing the auger difficult. In cases such as these, a portable power auger may be used to reach the desired depth. The sample can then be collected as described in the previous paragraph. The portable power auger consists of a powered drive unit (hand-held) used by sampling personnel to drive crew-like auger flights. The auger flights should be cleaned using the same procedures as for the other soil sampling equipment (Attachment A). For safety reasons, the portable power auger should never be used with less than two sampling personnel present.

The split spoon sampler may be used for sampling at greater depths. Because of its weight, the split spoon sampler is generally used with power equipment, i.e., drilling rig. A hollow stem auger is used to advance the hole to the desired depth. The split spoon is added to the correct length of drill rod and forced into the undisturbed soil by means of a 140-pound weight or hammer. The split spoon is retrieved from the hole and opened to reveal the sample. The top two or three inches of the sample normally will be disturbed and should be discarded. The undisturbed portion should be placed in a glass pan by means of a clean stainless steel spoon

or spatula. The procedure is repeated until the desired amount of sample is collected. The sample should then be thoroughly mixed.

4.7.2.4 Special Precautions for Trace Contaminant Soil Sampling. The procedures outlined in Section 4.1.11 shall be followed. All soil sampling equipment used for trace contaminants should be constructed of stainless steel where possible. In no case will chromium, cadmium, or galvanized plated or coated equipment be used for soil sampling operations. Similarly, no painted equipment shall be used. All paint and primer must be removed from soil sampling equipment by sandblasting or other means, before such equipment can be used for collecting soil samples.

4.7.2.5 Soil Samples Collected for Purgeable Organic Compounds Analyses. Soil samples collected for purgeable organic compounds analyses will be containerized without mixing as soon as possible after sampling. The sample should be placed in the sample container so that no head space is left in the container after the container is closed. California tubes with grass ring liners will be incorporated into site-specific plans as needed.

4.7.2.6 Specific Sampling Equipment Quality Assurance. Drilling rigs and other major equipment used to collect soil samples shall be identified so that this equipment can be traced through field records. A log book shall be established for this equipment so that all cleaning, maintenance and repair procedures can be traced to the person performing these procedures and to the specific repairs made. Sampling spoons, hand augers, Shelby tubes, and other minor disposable type equipment are exempted from this equipment identification requirement.

All equipment used to collect soil samples shall be cleaned as outlined in Attachment A and repaired, if necessary, before being stored at the conclusion of field studies. Any cleaning conducted

in the field or field repairs should be thoroughly documented in field records.

4.7.2.7 Auxiliary Data Collection. In addition to historic information pertaining to an area or specific site/location that may be available from previous investigations (i.e., site screenings, water quality, well monitoring studies, etc.) information and data may be obtained from various city, county, state, and federal agencies.

A system of logging all pertinent data collected during drilling and sampling operations should be maintained. The test hole locations should be recorded and referenced to the site map and/or datum base so that each location can be permanently established. Samples should be accurately labeled with all pertinent site information at the time of sampling. See the BSAP-QAPP for sample labeling and field recording procedures.

4.8 Sediment Sampling-Special Equipment/Techniques

To collect a sediment sample from a streamed, a variety of methods can be used. Dredging (Peterson, Eckman, Ponar), coring, and scooping (BMH-60) are available. Regardless of the method used, precautions shall be taken to ensure that the sample collected is representative of the streamed. These methods are discussed in the following paragraphs.

4.8.1 Dredging

For routine analyses, the Peterson dredge is preferable when the bottom is rocky, in very deep water, or when the stream velocity is high. The dredge should be lowered very slowly as it approaches bottom, because it can displace and miss lighter materials if allowed to drop freely.

The Eckman dredge has only limited usefulness. It performs well where bottom material is unusually soft, as when covered with organic sludge or light mud. It is unsuitable, however, for sandy, rocky, and hard bottoms and is too light for use in streams with high velocities. It should not be used from a bridge more than a few feet above the water, because the spring mechanism which activates the sampler can be damaged by the messenger if dropped from too great a height.

The Ponar dredge is a modification of the Peterson dredge and is similar in size and weight. It has been modified by the addition of side plates and a screen on the top of the sample compartment. The screen over the sample compartment permits water to pass through the sampler as it descends thus reducing the "shock wave." The Ponar dredge is easily operated by one person in the same fashion as the Peterson dredge. The Ponar dredge is one of the most effective samplers for general use on all types of substrates.

4.8.2 Corers

Core samplers are used to sample vertical columns of sediment. They are particularly useful when a historical approach to sediment deposition is desired for they preserve the sequential layering of the deposit. Many types of coring devices have been developed depending on the depth of water from which the sample is to be obtained, the nature of the bottom material, and the length of core to be collected. They vary from hand push tubes to weight or gravity driven devices.

Coring devices are particularly useful in pollutant monitoring because the "shock wave" created by descent is minimal, thus the fines of the sediment-water interface are only minimally disturbed; the sample is withdrawn intact permitting the removal of only those layers of interest; core liners manufactured of glass or Teflon™

can be purchased, thus reducing possible sample contamination; and the samples are easily delivered to the lab for analysis in the tube in which they were collected. The disadvantage of coring devices is that a relatively small surface area and sample size is obtained often necessitating repetitive sampling in order to obtain the required amount for analysis. Because it is felt that this disadvantage is offset by the advantages, coring devices are recommended in sampling sediments for trace organic compounds or metals analyses.

In shallow, wadeable waters, the direct use of a core liner or tube manufactured of Teflon™ or glass is recommended for the collection of sediment samples. Their use can also be extended to deep waters when SCUBA equipment is available. Teflon™ is preferred to avoid glass breakage and possible sample loss. Stainless steel push tubes are also acceptable and provide a better cutting edge and higher strength than Teflon™. The use of the glass or Teflon™ tube by itself eliminates any possible metal contamination from core barrels, cutting heads, and retainers. The tube should be approximately 12 inches if only recently deposited sediments (8 inches or less) are to be sampled. Longer tubes should be used when the depth of the substrate exceeds eight inches. Soft or semi-consolidated sediments such as mud and clays have a greater adherence to the inside of the tube and thus can be sampled with larger diameter tubes. Because coarse or unconsolidated sediments such as sands and gravel tend to fall out of the tube, a small diameter is required for them. A tube about two inches in diameter is usually the best size. The wall thickness of the tube should be about 1/3 inch for either Teflon™ or glass. The inside wall may be filed down at the bottom of the tube to facilitate entry of the liner into the substrate.

Caution should be exercised not to disturb the area to be sampled when the sample is obtained by wading in shallow water. The core tube is pushed into the substrate until only four inches

or less of the tube is above the sediment-water interface. When sampling hard or coarse substrates, a gentle rotation of the tube while it is pushed will facilitate greater penetration and cut down on core compaction. The tube is then capped with a Teflon™ plug or a sheet of Teflon™ held in place by a rubber stopper or cork. After capping, the tube is slowly extracted, the negative pressure and adherence of the sediment keeping the sample in the tube. Before pulling the bottom part of the core above the water surface, it too is capped.

To help prevent contamination from direct contact between the sampler's hand and the upper part of the tube, a collar-type device should be constructed of wood and should have a circular recess to accept the top of the tube. The recess should have a hole in it to allow water to pass through when pushing the tube in, and should be lined with sheet Teflon™. Handles should be attached to the sides of the collar. After the tube is driven in, impart a wide circular motion to help loosen the core for easy removal; take off the collar device; cap the top of the tube (as described above); pull it up out of the sediment layer; and cap the bottom of the tube before removing it from the water.

4.8.3 Scooping

If the water is wadeable, the easiest and most acceptable way to collect a sediment sample is to scoop the sediment using a stainless steel spoon or grain scoop. This reduces the potential for cross-contamination. This method is accomplished by wading into the stream, and while facing upstream (into the current), scooping the sample along the stream bottom in the upstream direction. If the stream is too deep to wade but less than eight feet deep, a stainless steel grain scoop attached to a piece of conduit can be used either from the banks if the stream is narrow or from a boat.

If the stream has a significant flow and is too deep to wade, a BMH-60 sampler may be used. It is not particularly efficient in mud or other soft substrates because its weight will cause penetration to deeper sediments, which are not desired when sampling for priority pollutants. It is also difficult to release secured samples in an undisturbed fashion that would readily permit subsampling. The BMH-60 may be used for priority pollutant sampling provided that caution is exercised by only taking subsamples that have not been in contact with the metal walls of the sampler.

4.8.4 Mixing

Regardless of the method of collection, sediment (and soil) samples collected for chemical analysis should be thoroughly mixed before being placed in the appropriate sample containers. The sediment should be removed from the sampling device (dredge, core tube, scoop, etc.) and placed in a glass or Teflon™ coated stainless steel pan, then thoroughly mixed using a stainless steel or Teflon™ coated stainless steel spoon. The sediment in the pan should be scraped from the sides, corners, and bottom of the pan, rolled to the middle of the pan, and initially mixed. The sample should then be quartered and moved to the four corners of the container. Each quarter of the sample should be mixed individually. Each quarter is then rolled to the center of the container and the entire sample is mixed again.

This procedure should be continued to ensure that all parts of the sample are mixed and that the sample is as homogeneous as possible before being placed in the sample containers.

4.8.5 Special Sample Collection Techniques

Many contaminants are partitioned more strongly to sediments than water; thus, if these pollutants have been deposited recently

and are not quickly degraded or desorbed, they are evident in the sediment analysis. Ideally, only Teflon™, stainless steel, or glass should be used in sediment sampling for priority pollutant analyses. The method using coring tubes, was discussed previously, is the preferred technique.

In many situations when the water is deep or the only sampling location is from a bridge, a dredge may be used. In these cases, a high grade stainless steel Ponar dredge (properly cleaned) shall be used to collect the sediment samples. Direct scooping of the streamed sediment as described in Section 4.8.3 is acceptable.

4.9 Landfills and Hazardous Waste Site Sampling

Sampling procedures for collecting soil, sediment, water, and ground-water samples at hazardous waste sites and landfills are identical to those given in the previous sections. The only difference is the degree of caution and safety precautions and procedures utilized for on-site samples collected from hazardous waste sites. Waste sampling procedures are included in the Waste Sampling Section. Where possible, disposable sampling equipment shall be used to collect on-site samples from hazardous waste sites. All "hot" or "concentrated" samples shall be clearly labeled as such when they are submitted for laboratory analyses. Any observations (odor, appearance, container labeling, etc.) made by the field team which might alert the laboratory to potential dangers or provide laboratory personnel with information on possible constituents in the samples (high concentration, etc.) shall be explained on the sample label and explained verbally to the sample custodian or other laboratory personnel, as necessary.

4.9.1 Specific Quality Control Procedures for Sampling Equipment

All major sampling and safety equipment used during investigations at hazardous waste sites including barrel openers,

safety equipment (other than disposable gear), Geiger counters, explosion meters, cameras, etc., shall be numbered so the equipment can be traced through field records. A log book shall be established for all equipment, so that cleaning, maintenance, and repair procedures can be traced to the person performing such procedures and to specific repairs made. Quality control procedures for certain pieces of equipment, such as pumps, soil sampling equipment, etc., are contained elsewhere in this manual.

All equipment utilized to collect samples at hazardous waste sites shall be cleaned as outlined in Attachment A and repaired, if necessary, before being stored at the conclusion of a field study. In some instances, special decontamination procedures in excess of the cleaning procedures outlined in Attachment A will be necessary. These procedures will be developed on a case-by-case basis according to the specific material encountered. Provisions should also be made for disposal of contaminated disposable equipment.

All equipment shall be tested before being used for field studies. Any cleaning procedures conducted in the field (Attachment A) or field repairs, shall be thoroughly documented in field records.

4.10 Waste Sampling

4.10.1 Pits, Ponds, and Lagoons

For the purposes of this subsection, pits, ponds, and lagoons refer to any basin, pit, or open tank, lined or unlined, which contain or are suspected of containing unknown concentrated liquid chemical waste. This discussion does not include municipal and industrial wastewater treatment ponds or natural or man made surface water impoundments.

4.10.1.1 Sampling Locations. Sampling locations within pits, ponds, and lagoons should yield samples which are representative of that section, or of the entire pit, pond, or lagoon being sampled. All phases in the pit, pond, or lagoon (floating solids, all liquid phases, and sludge) should be sampled. The only exception to this policy will be situations where representative samples cannot be safely collected or where the investigative team is attempting to determine worst case conditions.

Because of the inherent dangers with sampling known or unknown concentrated waste, sampling personnel should never attempt to sample pits, ponds, and lagoons by using a boat. All sampling should be accomplished from the banks of pits, ponds, and lagoons, or from piers. Any deviation from this policy must be cleared with the Project Manager.

4.10.2 Liquid-Waste Sampling

4.10.2.1 Sampling Equipment. The following equipment may be used in collecting liquid waste samples from pits, ponds, and lagoons: sampling containers; sampling container affixed to a piece of conduit pipe; stainless-steel scoop affixed to a piece of conduit pipe with tape or scoop bracket; stainless-steel spoon attached to a conduit pipe; peristaltic pump and vacuum jug arrangement; Bacon-Bomb samplers; and profile tubes for phase determination and possible sampling.

4.10.2.2 Sampling Techniques. If the sampling technique utilized requires multiple aliquots, or if the final sample will consist of aliquots from several different locations in the pit, pond, or lagoon, all aliquots should be placed into a pyrex dish or large glass sample container, or other suitable compositing container, and mixed thoroughly before containerization.

Floating solids can be sampled directly or with a stainless-steel scoop or spoon attached to a piece of conduit pipe.

The presence of individual liquid phases can be determined by using a profile tube. The top liquid phase can be sampled by direct dipping with the sample container; dipping with the sample container attached to a conduit pipe, either directly or by way of a fishing pole type arrangement, or dipping the sample with a stainless-steel scoop attached directly to conduit pipe. Other liquid phases can be sampled with a peristaltic pump/vacuum jug arrangement with the end of the Teflon™ tube intake attached to a conduit pipe and held at the desired depth or with Bacon-Bomb sampler opened at the desired depth. The Bacon-Bomb sampler can be operated directly from the banks of pits, ponds, and lagoons or from piers or operated by way of a fishing pole type arrangement using a piece of conduit pipe.

4.10.3 Sludge Sampling

4.10.3.1 Sampling Equipment Available. The following equipment may be used in collecting sludge samples from pits, ponds, and lagoons: Stainless-steel ponar dredges; stainless-steel scoop attached to a conduit pipe; and stainless-steel push tubes.

4.10.3.2 Sampling Techniques. If the sampling technique involves multiple aliquots, or if the final sample will consist of aliquots from several different locations in the pit, pond, or lagoon, all aliquots should be placed into a Pyrex™ dish or other suitable container and mixed thoroughly before containerization.

Sludge samples can be collected by pushing a stainless-steel push tube into the sludge and emptying the tube contents into a Pyrex™ or other suitable container. "Emptying" can include shaking to remove sludge or extrusion of thick or gummy sludges with a new wooden dowel. A disadvantage of this technique is the need for

multiple insertions of the tube into the sludge to collect sufficient sample volume.

Sludge samples can also be collected with a stainless-steel ponar dredge. An advantage of this technique is that one operation of the dredge usually yields sufficient sample volume for most sampling efforts.

On of the easiest methods of collecting a sludge sample consists of attaching a stainless-steel scoop to a piece of conduit pipe with either strapping tape or a scoop bracket, and dipping the scoop into the sludge. An advantage of strapping tape is that it generates less equipment to decontaminate. However, glue on the tape may dissolve rapidly in oily or solvent type wastes. The scoop bracket has a decided advantage in that it allows sampling personnel to adjust the angle between the scoop an the conduit pipe.

4.10.4 Open and Closed Container Sampling

Sampling of closed containers (drums, barrels, tanks) should only be conducted when absolutely necessary. Whenever container sampling is necessary, the first priority should be the collection of samples from open containers since open containers generally present less hazard to the samplers than closed containers (i.e., volatile components have already evaporated, extreme acute toxicity would probably be evident from dead animal life or vegetation around the site.) Closed containers must be considered as extremely hazardous from either the toxicity, explosion, or fire standpoints. Chronic toxicity may be a danger in both open or closed containers.

Safety procedures for container sampling will be in accordance with the Health and Safety Plan, Appendix 1.5 of Volume 1.0.

4.10.4.1 Stratification/Phase Separation. A problem which often arises in container sampling is stratification and/or phase separation of the container contents. When this condition occurs or is suspected, care must be taken to ensure that the sample collected is representative of the container contents. If only one layer or phase is sampled, this should be noted and taken into account when interpreting analytical results. For example, if a large tank is being sampled for PCBs and the only valve or access port available for sampling is at the bottom of the tank, it should be noted that the concentration of PCBs might be biased toward high concentrations, since PCBs are heavy and tend to collect near the bottom of a container.

Where possible, samples should be composited with depth (i.e., collected throughout the entire depth of the container or at several different depths) to provide a representative sample. When a drum or cylindrical container is standing vertically, depth compositing provides a good quantitative estimate of the container content. In other cases where such containers are tipped, horizontal, deformed, etc., depth compositing will provide a representative sample at least on a qualitative basis. (Note: A quantitatively representative sample could be collected, but would require sophisticated sampling methodology involving multi-layer sampling and volume measurements; this is not recommended unless initial screening indicates it is absolutely necessary.)

4.10.4.2 Equipment. The following equipment may be used in collecting waste samples from open and closed containers: a complete set of spark-proof tools including barrel bung wrenches, adjustable wrenches, etc.; a remote barrel opening device; glass tubes for barrel sampling; glass profile tubes for container sampling; Bacon-Bomb samplers for container sampling; and peristaltic pumps and vacuum bottle arrangements for liquid-waste sampling from containers.

4.10.4.3 Sampling Techniques. Closed drums, barrels, or other containers (including storage tanks) containing unknown materials or known hazardous materials should be opened only using spark proof opening devices. A remotely controlled device may be used when deemed necessary. Such a device involves the use of a remotely operated pneumatic wrench along with a brass pressure fitted bung socket.

Samples from drums or barrels can be collected using a four-foot length of glass tube. In most instances, glass tubes with a one-half inch or less inside diameter work best. The tube is inserted into the opening of the drum or barrel as far as possible. The open end is then sealed either with the thumb or a rubber stopper to hold the sample in the tube while removing the tube from the container. The sample is then placed in the appropriate container and the procedure is repeated until an adequate amount of sample is collected. Sample volume shall be held to the absolute minimum required for analysis. An optional method involves the use of a piercer valve which is inserted into the drum or barrel using a remotely operated hydraulic jack; however, this method should be used only as a last resort. Several valves may be required at different depths on the drum or barrel if stratification has occurred. The sample is collected directly from the valve.

Other sampling procedures that include the use of automatic samplers, pumps, siphons, multiple valves and ports, etc. may be used depending on the specific container involved. These procedures should not be used unless it can be established that their use will not constitute a fire or explosion hazard. This determination shall be made only after field reconnaissance, collection of appropriate field data (explosion meter, photoionizer, etc.) and consideration of available file information on the site.

Tank trucks and storage tanks containing liquid wastes are a special case. Samples may be collected from access ports on top of these tanks or trucks using the techniques outlined above. Tank trucks are often compartmentalized and the investigator should insure that all compartments of the tank truck are sampled. Sampling from discharge valves usually found on tank trucks is not recommended due to potential stratification of tank contents. However, if the investigator has to sample from a tank truck discharge valve, the valuing arrangement of the particular tank truck being sampled must be clearly understood to ensure that the contents of all compartments are sampled. The same precautions apply to sampling from storage tank valves. In either case, the investigator must realize that samples obtained from valves (particularly those at or near the bottom of tank truck and storage tanks) may not yield representative samples.

4.10.5 Waste Piles

Waste piles may consist of sludges and solid waste, liquid waste mixed with soil, or any type of waste mixed with construction debris, household garbage, etc. Each situation presents a unique challenge to the sampler in the selection of an appropriate sampling location and technique.

4.10.5.1 Sampling Locations. Sampling locations should be selected which will yield a sample which is representative of the waste pile being investigated. The only exception of this policy will be situations in which representative samples cannot be collected safely or where the investigative team is attempting to determine worst case conditions. A representative sample from a small waste pile can often be obtained by collecting a single sample. The collection of a representative sample(s) from large waste piles, however, presents problems with both the number and locations of samples. For a sample(s) to be truly representative, a statistical approach should be used in selecting both the number

of samples and the location where they are to be collected. A discussion of statistical methods which can be utilized is given in Chapter Nine, Volume II of the manual entitled Test Methods for Evaluating Soil Waste (SW-846), Third Edition, issued by the EPA Office of Solid Waste and Emergency Response.

4.10.5.2 Equipment Available. The following equipment may be used in collecting samples from waste piles: stainless-steel hand augers; stainless-steel push tubes; stainless-steel shovels; stainless-steel scoops; and stainless-steel spoons.

4.10.5.3 Sampling Techniques. All samples collected should be placed into a Pyrex™ dish and mixed thoroughly before containerization. Stainless-steel shovels, spoons, or scoops should be used to clear away surface material before samples are collected. Near surface samples can then be collected with a clean stainless-steel spoon. Depth samples can be collected from the cleared location by forcing a stainless-steel push tube into the pile or by augering to the desired depth with a stainless-steel hand auger. When the desired depth is reached with a hand auger, a clean auger head should be used for collecting the sample. An alternate method for collecting depth samples is to dig to the desired depth with a stainless-steel shovel or scoop and collecting the sample with a stainless-steel spoon.

4.10.5.4 Specific Quality Control Procedures for Sampling Equipment. All major sampling and safety equipment used during investigations at hazardous waste sites including barrel openers, safety equipment (other than disposable gear), Geiger counters, explosion meters, cameras, etc. shall be identified so that this equipment can be traced through field records. A logbook shall be established for this equipment, so that all cleaning, maintenance, and repair procedures can be traced to the person performing such procedures and to specific repairs made. Quality control procedures for certain pieces of equipment, such as automatic

samplers, pumps, soil sampling equipment, etc. are contained elsewhere in this manual.

All equipment used to collect waste samples shall be cleaned as outlined in Attachment A and repaired, if necessary, before being stored at the conclusion of a field study. In some instances, special decontamination procedures in excess of the cleaning procedures outlined in Attachment A will be necessary. These procedures will be developed on a case-by-case basis according to the specific material encountered and described in the FSP. Provisions should also be made for disposal of contaminated disposable equipment.

All equipment shall be tested before being taken out for field studies.

Any cleaning procedures conducted in the field (Attachment A) or field repairs, shall be thoroughly documented in the field logbooks.

4.10.5.5 Collection of Auxiliary Information. The collection of auxiliary information and data is particularly important when collecting waste samples. Any field analyses, including those conducted with safety equipment such as photoionizers, explosion meters or approximate analyses such as those obtained with pH indicator paper shall be recorded in field logbooks. Sketches of sampling locations, arrangements of tank trucks and storage tanks, markings on barrels, drum tanks, etc. should be thoroughly documented and in the logbooks. Photographs are particularly useful for recording this information and they should be used extensively during waste sampling operations.

4.11 Sampling for Radionuclides

The kinds of measurements that are required for radiochemical analysis are dictated by standard practices plus knowledge of the physical and biological behavior of radioactive isotopes in the environment. The amount of radionuclide material in the environment, the rate of dilution, the opportunities for biological reconcentration, and the biochemical characteristics of the isotopes involved all influence the kind of sampling procedures and protocol that are required. In general, the procedures described for sampling soil, surface water, and air are applicable to sampling for radionuclides analysis. However, these procedures are subject to appropriate modifications to health and safety factors based on the results of radiological surveys.

4.11.1 Surface and Soil Deposition

Various simple devices have been used for collecting samples of radioactive debris settling to the surface of the earth as dry dust or in precipitation. If one is concerned with the possibility of food-chain contamination, such a fallout sample may be preferable to other forms of environmental sampling because it indicates the amount of contamination per unit area of ground surface. A simple method involves the use of a 1-ft^2 acetate film covered with a sticky substance, mounted horizontally on a frame about 3 ft above the ground.

Coatings are commercially available which retain their adhesive properties when wet; dust particles may be entrapped efficiently even if contained in raindrops. Collectors of this type may be changed often and analyzed by reducing the acetate film to ash. If ashing is conducted at 500 to 550°C, some volatile isotopes such as iodine and ruthenium will be lost. However, in most cases, these isotopes are a small fraction of the total activity. This method of collection, because of its simplicity,

was used for many years throughout the world in making hundreds of daily measurements of the fallout from weapons testing. A disadvantage of this method is that some of the soluble radioisotopes may be removed preferentially from the film by rainfall. Although the amount washed off is not sufficient to affect the total beta count of sample by more than a few percent, radiochemical analysis for individual radioisotopes becomes unreliable. The fallout of individual radionuclides can, however, be approximated from knowledge of the total beta activity if the age of the debris is known.

Other types of collectors have been developed that employ a funnel system to overcome this objective. The fallout can be washed from the funnels directly into flasks and then transported to the laboratory for radiochemical analysis, or the rainwater or washwater can be passed through an ion-exchange column which removes most of the fission products. In order to collect large samples of deposition, some investigators have covered entire roofs with plastic film and have allowed the rainwater to run off the roof into collection barrels. The method of choice will be dictated by the purpose of the sampling program and the desired sensitivity.

One method of obtaining a cumulative sample of fallout is to collect surface soil for radiochemical analysis. Soil makes an excellent sampling medium, but it is unfortunately a difficult matrix from which to extract the radioactive substances for radiochemical assay.

The problems of sampling soil have been considered in connection with investigation of the worldwide distribution of strontium-90 from weapons testing. A favorable technique includes selection of sites that have a good vegetative cover and which are nearly level. Sites subject to overwash from higher ground or flooding should be avoided. Soils that pack when dry should also

be avoided, as should sites that have a high population of worms that might affect the vertical distribution of isotopes. These criteria are particularly important where it is desired to obtain, by means of soil sampling, an estimate of the total amount of fallout in a given area. In a worldwide sampling program, an attempt was made to sample known areas to a known depth. This was done with the use of augers by which precisely dimensioned borings could be obtained. Multiple borings covering an area of from 1 to 2 ft^2 to a depth of six inches were found to provide representative samples.

Because radiochemical analysis of soils from radionuclides is a complicated procedures, it is desirable to reduce the bulk of the original sample to the extent practical. For many purposes it will suffice to sample to a depth of only one-half to one inch.

Whether or not one removes vegetation and organic debris from the surface soil to be sampled depends on the purpose of the sampling. Where one wishes to estimate the amount of fallout deposited on a given area, the vegetation and debris should be analyzed along with the soil.

Grass is an excellent medium for trapping surface fallout and can be used as a sensitive indicator or fallout. It is particularly useful if a deposit of fresh fission products is suspected (see Section 4.7. Soil/Sediment Sampling).

4.11.2 Atmospheric Sampling

The general procedure used in sampling the atmosphere for radioactive particulate activity is to draw air through a filter at a known rate for a known period of time. The radioactivity of the filters may then be counted and the activity per unit volume of air ascertained.

The measurement of alpha activity is complicated by the fact that the atmosphere normally contains natural short-lived alpha activity in concentrations that are usually higher than the permissible concentrations of long-lived alpha activity one might wish to measure. The natural alpha activity of the atmosphere tends to mask the presence of long-lived alpha emitters. Fortunately, the natural alpha-emitting radionuclides in the atmosphere are short-lived and if one permits them to decay for six or eight hours, the short-lived nuclides will have decayed to a level which makes it possible for one to measure the presence of long-lived emitters.

The beta activity of the dust normally present in the atmosphere is approximately the same order of magnitude as its alpha activity. However, the radiotoxicity of beta-emitting dust is very much less than that of the alpha emitters, and the maximum permissible concentrations in the atmosphere are correspondingly higher. The concentration of beta activity in the atmosphere from natural sources is frequently of the same order of magnitude as the maximum permissible concentration of beta-emitting isotopes, and for this reason a period of 24 hours before counting to permit decay of the short-lived natural radionuclides is desirable after sample collection. However, it may be ascertained immediately that no acute emergency exists if the beta activity that is observed is so low that it is difficult to differentiate from natural radioactivity.

Several types of filter media are used for air sampling. Those most commonly used for the collection of dusts and fumes are either cellulose, glass, or mineral fibers. The cellulose filters are advantageous in that they can be dissolved in reagents or washed if it is desired to undertake radiochemical analysis, but the glass and mineral fibers tend to have a higher collection efficiency. Millipore filters, which are plastic membranes having a very high collection efficiency for particles as small as 0.01 ,

are also available. The uncertainties in estimating the human hazard from inhaling radioactive dust are so great that small differences of the order of 10 to 20 percent due to imperfection in filter performance are relatively unimportant and would not affect the evaluation of a given set of data. All the commercial filter media, when used properly, have efficiencies that usually are more than adequate to serve the purpose.

Radioiodine released from freshly irradiated fuel is apt to exist in vapor form and will not be retained by filter media such as are suitable for dusts. Activated charcoal has been shown to be effective for radioiodine sampling and may be used in series with dust filters.

Air samplers may be fixed or portable and may be devices that simply collect the dust on filter papers for counting in a laboratory or they may be equipped with automatic counting and recording devices.

Where power is available and where large samples are desired, a high volume air filter apparatus has proved to be very popular. When used without the carbon filter, the sampling rate varies from 20 to 50 cfm, depending on the filter media used. Most standard units may be used at the lower flow rate with Whatman No. 41 filter paper, with which the pump may be operated continuously for approximately one hour without significant overheating. For continuous duty a minimum of 30 cfm of air is required; this flow can be achieved by using circular filters manufactured for use in respirators designed to provide protection against toxic fumes.

An assembly that is widely used for remote locations is one which can be operated at a flow rate of 1 cfm from a battery pack or automobile storage battery.

Continuous atmospheric monitors are available which draw samples through moving tapes and automatically count the sample after permitting time for decay of the natural radioactivity. A continuous air sampler that is much simpler in construction draws air through a fixed filter which is mounted adjacent to a Geiger-Mueller counter. The radioactivity of the filter is continuously recorded. Provision is made to activate an alarm when the radioactivity level is more or less than predetermined values. The latter condition would indicate a loss of flow through the filter, causing its equilibrium radioactivity to drop below the expected level due to natural radioactivity.

4.11.3 Surface Water Sampling

Whether or not surface water samples should be collected on a routine basis would depend on the use of the water in relation to the quantities of radioactive substances available for contamination. For example, if the concentration of radioactive substances in the effluent is known to be well below the maximum permissible values permitted by the regulatory authority, there may be no need for water sampling. However, maximum permissible values are based on the concentrations that are safe for drinking water. It is possible for certain radionuclides to concentrate in mud and biota. If a stream is used as a source of drinking water, or for irrigation of crops, the water supply should be sampled at the point of intake for the water-supply system. If physical conditions permit, a continuous sample should be collected and analyzed weekly or monthly, a procedure which will serve as a check on the measurements made at the point of discharge into the waterway.

The total beta activity of such a sample will indicate if additional radiochemical analysis is necessary. If the total beta activity of the sample proves to be less than about 10^{-8} C/ml, as should ordinarily be true, no additional radiochemistry is usually

required. However, the principal isotopes contributing to the radioactivity of the drinking water should be identified if the concentration exceeds 10^{-8} C/ml.

Evidence of possible concentration of radionuclides should be sought in the muds and associated benthos downstream from the point of a discharge. The exact sampling point should be selected after some study of the characteristics of the river flow and sedimentation patterns, but in general, the first mud deposit downstream from the discharge will frequently make a satisfactory sampling point. The samples should be collected in duplicate or triplicate, depending on the observed variability.

Whether or not additional downstream or upstream sampling is required would depend on the data obtained. If a build-up of radioactivity is being observed in the muds and benthos, then the sampling program should be extended to include plankton, crustaceans, bottom-feeding fish, and other vertebrates.

A river or stream sampling program should be carefully designed with respect to its statistical aspects and the particular ecosystem within the stream. The samples should be collected with knowledge of the ecological relationships that exist. All samples should be sufficiently replicated so that the expected variability of the data can be understood (see Section 4.6, Surface Water Sampling).

4.11.4 Ground-Water Sampling

The transport of radioactive substances through soils proceeds at a slow rate. There is usually no basis for concern over possible ground water contamination except within very short distances (thousands of feet) of sites of ground storage of large quantities of radioactive wastes. Surface deposition of radionuclides should not be expected to permeate the ground to the

extent necessary to contaminant shallow or deep wells. However, deep wells have been known to be the source of natural radioactivity, principally from radium and radon.

Contamination of ground water is more of a concern where radiological facilities exist that maintain a high concentration of radionuclides in liquid media. The danger of leakage to the underground aquifers becomes an issue of greater importance, especially in the instance where practices have shown this potential; some of these practices include:

- o use of seepage basins
- o underground injection
- o underground storage tanks and sump/drainage systems

Ground water contamination is detected by extracting samples from wells drilled especially for this purpose. When contamination is detected, a network of wells is usually required to define the contamination plume (see Section 4.5 Ground-Water Sampling).

4.12 Air Monitoring Program

To assess the potential for off-site hazardous emissions, ambient air samples will be collected during site investigation as appropriate.

4.12.1 Preparation and Sampling Site Selection

Prior to performing sample collection, one upwind and two downwind sampling sites will be selected with the aid of a Qualimetrics Model 2133 Windicator portable wind indicating system or equivalent. To document the field conditions and equipment operation at the time of air sample collection, the contractor will complete an Air Sampling Data Sheet (Figure 8 in the QAPP). Selection of the upwind site will be made in an attempt to

characterize background levels at the upwind site perimeter before impacting the test site. Downwind locations will be chosen to represent air quality at the downwind perimeter to reflect the quality of air impacting any potential off-site receptors. The actual selection of sampling sites will be deferred until the day of testing at which time current meteorological data may be reviewed.

By deducting upwind levels (background) from downwind concentrations, the true impact of the site and ambient air quality may be determined. Meteorological data including ambient temperature, soil surface temperature, barometric pressure, wind speed, and direction, will be recorded at 15-minute intervals during each test. Once testing commences, if recorded wind direction data indicate a shift in wind direction the test will be temporarily stopped to permit an assessment of the true wind direction. In the event that a sustained shift in average wind direction of greater than a 45 degree angle occurs, the sampling stations will be repositioned to maintain their upwind/downwind orientation with respect to the site.

Currently, the use of 110 volt electrical power will be required at each sampling location.

The air sampling program when conducted, should be performed on three individual days to adequately characterize the upwind and downwind concentration of the compounds to be measured at and in the vicinity of the site. During the test period, a collocated sampler will be operated, for all sample trains, once at each of the upwind and two downwind sampling positions for each of the subject compounds to permit assessment of the overall precision for the test procedure. A sampling duration of 4 hours for each train has previously proven satisfactory in providing a sufficient quantity of sample to achieve reasonable detection limits while allowing maintenance of upwind/downwind orientation with respect to

the site. Experience has shown that the likelihood of a wind shift during an 8-hour sampling period is extremely high. Because these wind shifts are potential cause for sample network re-orientation or invalidation of the test, a 4-hour, rather than an 8-hour, sampling period was selected. The duration of the test may be adjusted, however, if visual inspection of filter medium during the test indicates over- or under-sampling. Additionally, replication of air monitoring on 3-individual days provides for a statistical database from which to evaluate the effects of temperature, humidity, wind speed and direction at the site.

4.12.2 Particulate and Metal Sampling

Air samples for particulate matter and metals will be collected with General Metals Works Model GMWS-2310 ACCU-VOL high volume samplers. Eight-by-ten inch glass fiber filters will be used as the collection medium. A calibrated flow rate of 42 cubic feet per minute (CFM) will be maintained by the electronic flow controller in each unit. Samples for particulates will be collected and analyzed in accordance with procedures specified in 40 CFR Part 50 Appendix B "Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere." Samples for metals analysis will be collected and analyzed in accordance with procedures specified in 40 CFR Part 50 Appendix G, "Reference Method for the Determination of Lead in Suspended Particulate Matter Collected from Ambient Air."

4.12.3 Semivolatile Organics Sample Collection

Air samples for semivolatile organics will be collected using General Metal Works PS-1 PUF sample pumps (or equivalent). Four-inch-diameter glass fiber filters coupled to glass cartridge XAD-2 absorbent will be used for collection of both particulate and vapor phase semivolatile organics. A flow rate of 3 CFM will be maintained for each test through the use of an in-line calibrated

flow orifice. Samples will be collected and analyzed in accordance with the specified guidelines in Method TO-13, "Compendium of Methods for the Collection and Analysis of Air."

4.12.4 Volatile Organic Sample Collection

Air samples for volatile organics for field analyses will be collected with Sensidyne Model BDX34 Super Sampler pumps (or equivalent). Tenax and activated charcoal tubes will be the collection medium. A flow rate of 0.05 liters per minute will be maintained for each test. If GC analysis shows greater than 10 percent breakthrough at this sampling rate, the test pit will be re-monitored at a lower target collection volume.

Air samples for laboratory analysis of VOCs will be obtained on a Tenax adsorbent medium in accordance with applicable specifications of Method TO-1. Sample gas will be drawn at a calibrated flow rate through approximately 1.5 grams of precleaned Tenax resin contained in a 1.6 centimeter (cm) I.D. by 10 cm long adsorbent tube. Sample flow rate will be maintained with a calibrated in-line critical flow orifice. Samples collected on Tenax will be analyzed for VOCs by a thermal desorption purge and trap technique in accordance with EPA Method 5040/8240.

4.13 Field Physical Measurements

Field measurements of topographic features, water levels, time of travel, geophysical parameters, and physical dimensions may be required during the comprehensive water quality, hazardous waste and related field investigations. The scope of such measurements obviously depends on the purpose of the particular investigation.

All sampling locations shall be depicted on a scaled drawing or a topographic or other standard map, or be referenced in such a manner that their location(s) are firmly established.

Each field measurement made shall be traceable to the actual person making the measurement and to the field equipment used to make that measurement. All equipment maintenance and calibration records shall be kept in log books and field records so that all such procedures are traceable. All time records shall be kept in local time using the 2400 hour format, and time shall be recorded to the nearest five minutes.

4.13.1 Site Mapping

4.13.1.1 Procedures. Site maps should be prepared for all hazardous waste site investigations and/or other investigations that may result in enforcement actions. Drainage patterns, building, storage containers/ponds, surface water bodies, point source discharges, sampling locations, and other pertinent features should be depicted on a scaled drawing or map. Maps should be noted with degree of accuracy, e.g., "map prepared by standard engineering topographic mapping techniques" or "map prepared by approximated distances." In addition, all maps should be oriented using a north arrow and should contain a descriptive title. Where appropriate, salient points (sampling points, drums, surface spills, etc.) may be described in a narrative to the map. Such a narrative should provide a location description of the salient point by providing a compass bearing and distance to a reference point, e.g., "250 feet north of Highway Bridge 44 on State Route 47."

In general, maps should be accurate to with ± 10 percent of map scale and compass sitings should be within ± 5 degrees. A Registered Land Surveyor will prepare the maps and sign and seal them.

Enforcement-oriented investigations should include photographs of all sampling points and pertinent features. All photographs should contain information regarding date, time, PSC number, and

name of person taking the photograph. A log of these photographs must be made in the field records. Presentation of the photographs in reports should include an orientation map as standard procedures.

4.13.1.2 Equipment. The following equipment may be used in preparing site maps and documenting the location of sampling points:

- Camera,
- Transit,
- Theodolite/electronic distance meter (EDM),
- Engineers level,
- Steel tape,
- Cloth tape,
- Optical tape measure,
- Rola tape,
- Compass,
- Range pole,
- Level rod,
- Stadia rod, and
- Reflector prisms.

4.13.1.3 Specific Equipment Quality Control Procedures. All field surveying methods using transits, EDM, and engineering levels shall be made only by personnel who have been trained to use them.

Each piece of field equipment (as appropriate) shall be numbered, and a log book shall be kept containing all maintenance and calibrations made on the equipment. The following specific maintenance and calibration procedures shall be used for all site mapping equipment.

Transits, EDM, and Engineering Levels -- This equipment shall:

- be serviced and calibrated by a qualified private service shop every five years;

- be checked out using procedures outlined in basic surveying textbooks and appropriate users manuals before use; and

- be cleaned and maintained using procedures outlined in basic surveying textbooks and appropriate users manuals during field use and before being returned to storage.

Steel and Cloth Measuring Tapes, Mechanical Rola-Tape -- The following procedures shall be used for all measuring tapes:

- All measuring tapes and the mechanical Rola-tape will be calibrated against an Invar steel surveyors chain. Those steel tapes that are not within 0.10 ft per 100 ft long or cloth tapes not within 0.20 ft per 100 ft shall be discarded. The shorter carpenter-type steel tapes (6-12 ft) shall check within 0.10 ft or they will be discarded.

- All tapes shall be checked to see that they are not damaged and are clean before use and after use before storage.

Compass -- All compasses shall:

- be checked for magnetic bearings by comparing them to Branch precision transits, and

- be cleaned after use and before storage. They should not be used in or exposed to strong electrical fields.

Level Rods, Stadia Rods, Range Poles, Reflector Prisms -- All of this equipment shall:

- o be checked for warpage and/or damage before use; and
- o be cleaned daily after use and before being returned to storage.

4.13.2 Ground Elevation Surveys (Vertical Control)

Standard engineering leveling techniques to be used by the Contractor or Sub-Contractor will be as described in basic surveying textbooks establish the methodology for providing vertical control. Datum for elevation control is the National Geodetic Vertical Datum (NGVD), established by the U.S. Coast and Geodetic Survey. Bench marks of known elevation will be used. If no bench mark is located in the vicinity, a bench mark will be established on a permanent location, e.g., bridge wingwall, foundation, or corner post. The location of all bench marks used shall be shown on the site sketch map. When practical, elevation surveys should be conducted to form a circuit. That is, the survey line should close back to a bench mark. Third order accuracy should be obtained on all level circuits. Third order accuracy is defined by the formula 0.05 foot ($miles^{1/2}$). That is, on a mile circuit, the closure should be within 0.05 ft.

Length of site shall not ordinarily exceed 250 ft with turning point back shots and fore shots deviating no more than 50 ft from one another.

4.13.3 Bathymetry

Recording fathometers are used to provide bathymetric traces of water depths. Because water depths are time dependent (especially in tidal areas), the date and time of all traces should

be noted. Operation manuals provide operation and calibration procedures to be followed. In particular, tide and draft adjustments provide datum calibration in regard to the respective tidal amplitude and sensor probe depth. All traces should be noted with transect description, chart speed, direction of travel, and pertinent reference points and then indexed to a site map. When working in tidal areas, a water stage recorder should be positioned to provide a histogram of water levels to correlate with the bathymetric trace. (During the initial setup of each survey, the fathometer calibration should be checked against a field measurement of water depth made using a graduated sounding line.)

4.13.3.1 Equipment. The following equipment may be used for bathymetric surveys:

- o recording fathometers;
- o water level recorder and/or referenced gaging station(s); and
- o calibrated sounding line(s).

4.13.3.2 Specific Equipment Quality Control Procedures. All equipment used for bathymetric studies shall be numbered and a record shall be kept of all maintenance and calibration procedures. The following procedures shall be used to maintain and calibrate bathymetric measurement equipment.

(a) Recording Fathometers -- These fathometers shall:

- o Be calibrated and maintained according to the manufacturer's instructions before use. The chart speed should be checked against a reliable time source before the instrument is sent to the field;

- o Be checked daily in the field against a field measurement of water depth utilizing a calibrated sounding line; and

- o Be cleaned daily after use and prior to being stored.

(b) Sounding Lines -- All sounding lines will be calibrated against a steel surveyors tape and shall be accurate ±3 percent.

4.13.4 Surface Water Stage/Tape Downs

4.13.4.1 Procedures. Water level recorders provide a time series record of water levels. Where possible, these instruments should be referenced to National Geodetic Vertical Datum (NGVD). All water level tracings should be noted with beginning and ending date and time, site location, stage scale, and time scale and user. Standard USGS staff gages should be employed at each water level recorder site to provide a reference and check on the recorder trace. Water stage should be recorded to the nearest 0.01 foot where possible.

Tape downs provide instantaneous water stage as referenced to a known elevation. An engineering tape is fashioned with a plumb bob to measure from a bridge deck or other reference point to the water surface. The plumb bob provides weight for the tape as well as providing a discernible contact with the water surface. All measurements should be noted to the nearest 0.05 foot accompanied by a date, time, and station location. The exact reference or point that a tape down is measured to shall be permanently marked on the reference (wing wall or bridge rail by etching a reference with a chisel, etc.) and a complete description of the reference shall be made in the field records.

Both of these procedures (water stage and tape downs) are predicated upon accurate reference to established measuring points. As mentioned above, the NGVD is an established datum that provides correlation of water surface recording to engineering structures (bridge, wing walls, sea wall caps, clarifier cat walks, etc.). When recording water level dynamics in relation to a particular flow device, the datum is established in relation to the flow device reference point. Rectangular and V-notch weirs, for instance, are proportional to the water level referenced to the weir crest or, in the case of partially filled pipes, the flow rate is proportional to the depth of flow. Therefore, when employing a water level recorder or tape down on primary flow devices the reference or datum is the weir crest or in the case of pipes, the invert.

4.13.4.2 Equipment. The following equipment may be used for surface water stage/tape down measurements:

- o Stevens Stage Recorder(s);
- o Flow Meter(s) and Recorder;
- o USGS Staff Gage(s); and
- o Weighted steel measuring tapes.

4.13.4.3 Specific Equipment Quality Control Procedures. A log book will be kept of all equipment used for making water stage/tape down measurements. The following maintenance and calibration procedures should be used (as appropriate) and recorded in the log book for all equipment used for water stage and tape down measurements.

(a) Stage Recorders -- Stage recorders shall:

1) Be maintained according to the manufacturer's instructions. Once yearly, each unit should be operated, and the time scale should be adjusted to

read within two percent of full scale. Once yearly, the recorders should be bench checked by moving the recording mechanism vertically. The units must be accurate and record to within 0.01 foot of the Invar steel surveyor's chain.

2) Be checked in the field by comparison with a staff gage. During field measurements, the vertical accuracy shall check within 0.05 foot, and

3) Be cleaned and maintained before storage.

(b) USGS Staff Gage(s) -- USGS staff gages shall:

1) Be checked on receipt from the vendor. Any staff gage not accurate to within 0.01 foot when compared with the Invar steel surveyor's chain should be discarded. All staff gages will be appropriately marked upon calibration.

2) Be checked for damage, warpage, legibility, etc., before use. Any damaged or illegible staff gages should be discarded.

3) Be cleaned after use before being stored.

(c) Weighted Steel Measuring Tapes -- Weighted steel measuring tapes shall

1) Be calibrated against the Invar steel surveyor's chain. The calibration shall be within 0.01 foot per 10 feet of length.

2) Be checked for damage before use; damaged tapes should be recalibrated or discarded.

3) All weighted tapes shall be cleaned after use before being stored.

4.13.5 Ground Water Level Measurement

The measurement of ground water level in wells is frequently conducted in conjunction with ground water sampling. Data from such measurements are needed to determine the "free" water surface and can be used to establish ground water gradients, and ultimately, the direction of ground water flow.

Total well depth measurements, along with ground water level measurements, are necessary to determine the volume of water in a well casing prior to purging the well during ground water sampling.

All ground water level measurements shall be made in reference to an established reference point on the well casing. This reference point shall be documented in field records. To be useful for establishing ground water gradient, the reference point should be tied in with the NGVD. An arbitrary datum common to all wells in a group could be used for an isolated group of wells if necessary. All ground water level measurements shall be made and recorded to the nearest 0.1 foot.

4.13.5.1 Specific Ground Water Level Measuring Techniques. Measuring the depth to the free ground water surface can be accomplished by the following methods:

(a) Weighted Tape -- This method is the same as the "bell sounder" except any type of weight can be used to fasten to the tape measure.

(b) Chalked Tape -- Chalk rubbed on a weighted steel tape will discolor or be removed when in contact with water. Distance to the water surface can be

obtained by subtracting the wet chalked length from the total measured length. The tape should be withdrawn quickly from the well because water has a tendency to rise up the chalk due to capillary action. A paste called "National Water Finder," (manufactured by the Metal Hose and Tubing Company, Dover, New Jersey), may be used in place of chalk. The past is spread on the tape the same way as the chalk, but the portion of the tape that gets wet turns red.

(c) Electric Water Level Indicators -- This instrument consists of a spool of dual conductor wire, a probe attached to the end, and an indicator. When the probe comes in contact with the water, the circuit is closed and a meter light and/or buzzer attached to the spool will signal the contact. Penlight batteries are normally used for a power source.

4.13.5.2 Total Well Depth Measurement. The weighted tape, chalked tape, or electric water level indicators described above can be used to determine the total well depth. This is accomplished by lowering the tape or cable until the weighted end is felt resting on the bottom of the well. In deep wells (greater than 80 feet), where the weight of the length of tape or cable lowered into the well is approximately equal to or greater than the weight of the weight at the tape or cable end, it can be difficult to determine when the bottom of the well is reached. All total well depth measurements must be made and recorded to the nearest 0.1 foot.

4.13.5.3 Equipment. The following equipment will be used for ground water level and total well depth measurements:

- o weighted steel measuring tapes, and

- o electric water level indicators.

4.13.5.4 Specific Quality Control Procedures. All devices used to measure ground water levels shall be calibrated against the Invar steel surveyor's chain. These devices shall be calibrated to 0.01 foot per 10 feet length. Before each use, these devices shall be prepared according to the manufacturer's instructions (if appropriate) and checked for obvious damage. These devices should be rinsed after use as described in Attachment A, and also before being used in the next well to be measured. All calibration and maintenance data shall be recorded in a log book.

4.14 Soil-Gas Survey

A soil-gas survey will be conducted at the Oil and Solvent Disposal Pits Area and the residential housing area to investigate the potential for contaminant transport and human exposure via soil-gas migration through the vadose zone. Sixty soil-gas probes will be installed during the investigation. Eleven permenant sample probes will be installed along the western and northern periphery of the family housing area. The sample and analysis plan for the soil gas contained in Attachment B describes the details for the probe designs, sample collection, sample analyses, and field quality assurance and quality control.

Table 1. Specific Field Analytical Methods

Analytical Parameter	Method	Equipment
Temperature	Calibrated glass (mercury) dial (mechanical), or electrometric thermometer	Mercury filled glass, mechanical dial-type thermometer, or thermistor with electronic readout.
pH	Electrometrically using a glass electrode in combination with a reference potential or a combination electrode	Portable field pH meter
Specific Conductance	Wheatstone bridge type or equivalent meter corrected to 25°C	Self-contained conductivity meter, Wheatstone bridge type, or equivalent with automatic temperature compensation to 25°C or "dial in" temperature compensation.
Organic Vapor	Organic Vapor Analyzer Flame Ionization Detector (FID)	Foxboro OVA 128
Volatile Organic Compounds	Gas Chromatography - PID	Photovac-PID HNu

5.0 SAMPLE HANDLING AND FIELD ANALYSES

Requirements for sample handling and field analyses beyond those previously described in Section 4.0 are presented in the sections below.

5.1 Sample Container Selection

Procedures for selecting appropriate sample containers are described in the BSAP-QAPP Section 4.1.2. Sample containers for each method including sample volumes, container type, preservative, holding times, and detection limits are presented in Table 1 of the BSAP-QAPP.

5.2 Sample Container Labeling

Procedures for sample container labeling are described in the BSAP-QAPP in Section 5.2. The sample identification system also is described in Section 5.2 of the QAPP and Section 3.0 of this BFSP.

Sample labels are necessary to properly identify the samples. Each sample container must have a sample label. Sample labels should be filled out in waterproof ink and it is recommended that clear tape be placed over the label. The label must include the following information:

1) Sample identification number

2) Initials of collector

3) Date and time of collection

4) Project number (as appropriate)

5) Analysis needed (parameters and method)

6) Sample matrix (ground-water, surface, water, soil, sediment, etc.)

7) Preservative

5.3 Chain-of-Custody Procedures and Shipping

The possession of samples or other physical evidence shall be traceable from the time they are obtained until they are introduced as evidence in legal proceedings.

The Chain-of-Custody Record is used to record the custody of all samples or other physical evidence collected and maintained by field personnel.

A Chain-of-Custody Record must be filled out completely (see Section 5.3 of the BSAP-QAPP). This document is necessary to track sample possession from time of collection to laboratory analysis. Information on this form must include:

1) Project identification or location

2) Shipping container ID number

3) Sampling personnel

4) Sample identification number

5) Date/time of sampling

6) Parameters to be analyzed and methods of analysis to be employed (see Table 3 of the QAPP)

7) Description of sample containers and number

8) Preservation of persons involved in chain-of-custody

9) Signatures of persons involved in chain-of-custody and the dates and times of possession

10) Delivery method (attach shipping bill)

11) The remarks column at the bottom of the form is used to record air bill numbers or registered or certified mail serial numbers.

The Chain-of-Custody Record is a serialized document. Once this record is completed it becomes an accountable document and must be maintained in the project file. QC procedures for chain-of-custody are described in the BSAP-QAPP in Section 5.3 and 5.4.

5.3.1 Field Custody Procedures

(1) To simplify the Chain-of-Custody Record and eliminate potential litigation problems, as few people as possible should handle the sample or physical evidence during the investigation or inspection.

(2) The Contractor field personnel are responsible for the care and custody of the sample collected until they are properly and formally transferred to another person or facility.

(3) Sample labels shall be completed for each sample, using waterproof, indelible ink.

(4) All samples must be documented by field sampling personnel in bound field logbooks.

(5) A Chain-of-Custody Record will be completed in indelible ink for all samples or physical evidence collected. A separate Chain-of-Custody Record will be utilized for each final destination or laboratory utilized during the inspection or investigation.

(6) During the course and at the end of the field work, the project leader or field investigator determines whether these procedures have been followed, and/or if the collection of additional samples are required.

(7) If chain-of-custody is required for documents received during investigations, they should be placed in large envelopes and the contents should be noted on the envelope. The envelope shall be sealed and a custody seal placed on the envelope such that it cannot be opened without breaking the seal. A Chain-of-Custody Record shall be maintained for the envelope. Any time the seal is broken, that fact shall be noted on the Chain-of-Custody Record and a new seal affixed. The information on the seal shall include the field investigator's signature, as well as the date and time of sealing.

(8) Other physical evidence such as video tapes or other small items shall be placed in Ziploc™ bags and a custody seal should be affixed so that the bag cannot be opened without breaking the seal. A Chain-of-Custody Record shall be maintained for items in the bag. Any time the seal is broken, a new seal shall be affixed. The information on the seal should include the field investigator's signature, as well as the date and time of sealing.

5.3.2 Transfer of Custody and Shipment

(1) All physical evidence or sample sets shall be accompanied by a Chain-of-Custody Record. When transferring the possession of samples, the individuals receiving the samples shall sign, date, and note the time that they received the samples on the form. This form documents transfer of custody of samples from the field investigator to another person, to the laboratories, or other organizational elements.

(2) Samples shall be properly packaged for shipment and delivered or shipped to the designated laboratory for analyses (Attachment B). Shipping containers shall be secured by using nylon strapping tape and custody seals. The custody seals shall be placed on the container so that it cannot be opened without breaking the seal. The seal shall be signed, dated, and the time recorded by the field investigator.

(3) When samples are split with a facility, state regulatory agency, or other government agency, the facility, state regulatory agency, or other government agency representative shall sign the Chain-of-Custody Record. The only exception is that a Receipt for Samples form will be used for RCRA and CERCLA samples as required by the appropriate regulations.

(4) All samples shall be accompanied by the Chain-of-Custody Record. The original and one copy of the record will be placed in a plastic bag inside the secured shipping container if samples are shipped. One copy of the record will be retained by the field investigator or project leader. The original record will be transmitted to the field investigator or project leader after samples are

accepted by the laboratory. This copy will become a part of the project file.

(5) If sent by mail, the package shall be registered with return receipt requested. If sent by common carrier, a Bill of Lading (BL) or Air Bill should be used. Receipts from post offices, copies of BLs, and Air Bills shall be retained as part of the documentation of the chain-of-custody. The Air Bill number, BL number, or registered mail serial number shall be recorded in the remarks section at the bottom of the Chain-of-Custody Record.

5.4 Field Analytical Procedures

Field analytical equipment shall be suitable for the analysis required and shall be properly calibrated. In addition to being accurate, field analyses must be conducted on a sample which is representative of the source from which it was collected. Therefore, the type of sample and location of the sampling site are critical.

The specific field analytical techniques that may be used are listed in the following Table 1 and the specific procedures for each analytical technique and field test are presented in subsequent sections.

Table 1. Specific Field Analytical Methods

Analytical Parameter	Method	Equipment
Temperature	Calibrated glass (mercury) dial (mechanical), or electrometric thermometer	Mercury filled glass, mechanical dial-type thermometer, or thermistor with electronic readout.
pH	Electrometrically using a glass electrode in combination with a reference potential or a combination electrode	Portable field pH meter
Specific Conductance	Wheatstone bridge type or equivalent meter corrected to 25°C	Self-contained conductivity meter, Wheatstone bridge type, or equivalent with automatic temperature compensation to 25°C or "dial in" temperature compensation.
Organic Vapor	Organic Vapor Analyzer Flame Ionization Detector (FID)	Foxboro OVA 128
Volatile Organic Compounds	Gas Chromatography - PID	Photovac-PID HNu

basis for later written reports, language should be objective, factual, and free of personal feelings or other terminology which might prove inappropriate. Once completed, these field logbooks become accountable documents and must be maintained as part of project files.

5.6 Departure from Site

The On-Site Coordinator will be notified prior to any person leaving the Site. Access keys or other items loaned while at the Site will be returned, work areas cleaned of disposable items, and well caps secured and locked.

5.5 Field Records

Proper record keeping ensures that there is complete documentation on all phases of field sampling and sample handling. Field personnel shall use only bound field logbooks for the maintenance of field records. Looseleaf forms for sampling logs (i.e. soil/sediment logs, water-sampling logs, etc.) may be used in conjunction with the field logbook. These forms should be bound during the data validation process as described in the Data Analysis Plan.

Field logbooks will be dedicated to individual OUs. The OUs name will be entered on the inside front cover of the logbook. All entries will be dated and time of entry recorded. At the end of each day's activity, or entry of a particular event if appropriate, a diagonal line will be drawn at the conclusion of the entry and initialed by responsible personnel indicating the conclusion of the entry or the days activity.

All aspects of sample collection and handling as well as visual observations shall be documented in the field logbooks. All sample collection equipment (where appropriate), field analytical equipment, and equipment utilized to make physical measurements shall be identified in the field logbooks as outlined in previous sections of this manual. All calculations, results, and calibration data for field sampling, field analytical, and field physical measurement equipment shall also be recorded in the field logbooks. All field analyses and measurements must be traceable in the specific piece of field equipment utilized and to the field investigator collecting the sample, making the measurement, or analyses.

All entries in field logbooks shall be dated, shall be legible, and shall contain accurate and inclusive documentation of an individual's project activities. Since field records are the

nearest ten units for readings under 1,000 umhos/cm and the nearest 100 units for readings over 1,000 umhos/cm.

c. Record the actual sample temperature when the measurement is made. Convert the meter reading to specific conductance at 25°C using the information in the manufacturer's instruction manual.

(4) Precision and Accuracy. Beckman Model RB-6 conductivity meter has an accuracy of ± 2 percent of reading. With satisfactory equipment, results within 1 percent of the true value should be obtained.

(5) References

Standard Methods for the Examination of Water and Wastewater, 15th Edition, p. 70, Method 205 (1980).

Annual Book of ASTM Standards, Part 31, "Water," Standard D1125-64, p. 120 (1976).

Methods for Chemical Analysis of Water and Wastes, US-EPA, 120.1 (1979).

Instruction Manual, SoluBridge™ RB-6, Beckman Instruments, Inc., Rev. January 1982.

5.4.1.4 Portable Gas Chromatography. Standard Operating Procedures for the Analysis of Volatile Organic Compounds with a Photovac 10S50 Portable Gas chromatograph are included in Attachment G of the QAPP.

(f) Method for Measuring Specific Conductance

(1) Scope and Application. This method is applicable to ground, surface, and saline waters, as well as domestic and industrial wastes.

(2) Summary of Method

a. The specific conductance of a sample is measured by use of a self-contained conductivity meter, Wheatstone bridge-type, or equivalent.

b. Samples are preferably analyzed at 25°C. If not, temperature corrections are made and results reported at 25°C.

(3) Test Procedure

a. Follow instructions manual for Beckman SoluBridge™ Model RB-5/RB-6 field conductivity meter or specific instructions for any other conductivity meter used.

b. Check the meter with two standard solutions of 100 and 1,000 umhos/cm. If the meter does not read within one percent of the standards, determine what the problem is and correct it before proceeding. Most field instruments read conductivity directly; with those instruments, follow the manufacturer's instructions. Report the results to the

Procedure No. 501, pH Measurement in Low Ionic Strength Solutions, Orion Application Information, Orion Research Incorporated.

5.4.1.3 Specific Conductance.

(a) Equipment -- A portable specific conductance meter, Wheatstone bridge type or equivalent should be used.

(b) Inspection and Calibration -- Each conductivity meter shall be checked before every field trip. Batteries shall be checked, and conductivity cells shall be cleaned and checked against known conductivity standards (KCl).

(c) Field Calibration -- Before using in the field, check instrument daily with known standards. Refer to the instrument instructions for temperature-conductance calculations. Duplicate field analyses should agree within ± 10 percent.

(d) Calibration and Repair Records -- A logbook shall be maintained with all specific conductance meter property numbers. All repairs and calibrations shall be noted. The logbook shall include all calibrations and repair information along with the name of the person making the repair.

(e) Reporting Units -- Results should be expressed in micromhos/centimeter (umhos/cm) corrected to 25°C. Results should be reported to the nearest ten units for readings under 1,000 umhos/cm and the nearest 100 units for readings over 1,000 umhos/cm.

n. Turn the slope indicator until the arrow of the temperature compensator points to the temperature of the solution.

o. Place the electrode into the sample, swirl and read pH value. In case of low specific conductance and meter drift, add 1 mL of 1M KCl solution to each 100 mL of sample, swirl sample and read pH.

p. Turn off meter after last reading.

q. Rinse electrode and store in rubber cap with distilled water.

(8) Precision and Accuracy. Under normal conditions, the accuracy is ± 0.1 pH unit.

(9) References

Standard Methods for the Examination of Wastewater, 15th Edition, p. 402, Method 423 (1980).

Instruction Manual for Models 399 A/F, 399 Analog pH Meter, Orion Research Incorporated, 1983.

Annual Book of ASTM Standards, Part 31, "Water," Standard D1293-78(B).

Methods for Chemical Analysis of Water and Wastes, US-EPA, 150.1 (1979).

f. Turn calibration control until the meter needle points to the pH value of the buffer.

g. Remove the electrode from the pH 7 buffer and rinse with distilled water.

h. Place electrode into the second pH buffer solution (pH 4 or pH 10).

i. Turn the temperature compensator knob until the meter needle points to the pH value of the buffer solution (pH 4 or pH 10).

j. Measure the temperature of the second buffer solution.

k. Turn the slope indicator until the arrow of the temperature compensator points to the actual temperature of the buffer. The percent of the theoretical slope can be read on the slope scale. A slope of less than 90 percent may be caused by a defective electrode or contaminated buffer. If a slope of less than 90 percent is obtained, correct the problem before proceeding.

l. Remove electrode from buffer and rinse thoroughly with distilled water.

m. Measure the temperature of a fresh grab sample.

sample or in-situ until values differ by no less than 0.1 pH unit. Two or three volumes are usually sufficient.

g. In the case of low specific conductance samples, such as encountered with some ground waters, add 1 mL of 1M potassium chloride solution per 100 mL of sample and follow steps e and f.

h. When the meter is moved to another sampling location, recheck the meter calibration by inserting the probe into the pH 7 buffer solution and follow steps 7F through 7L (below).

(7) Calibration Method for Most Field pH Meters

a. Check sample with pH paper to determine proper pH buffer range.

b. Turn on pH meter and check battery.

c. Turn function switch to pH position.

d. Select two buffer solutions (based on pH paper reading); one buffer solution shall be pH 7. Choose a second buffer so that the two bracket the anticipated sample pH.

e. Place pH electrode into pH 7 buffer solution.

b. Each meter/electrode system must be buffered at a minimum of two points that bracket the expected pH of the samples and that are approximately three pH units or more apart. Approximate pH values may be obtained by using multi-range pH paper.

(6) Test Procedure

a. Allow the meter to equilibrate to ambient temperature when it is removed from a field vehicle.

b. Buffer the meter at the temperature of the buffer solution as outlined above in Section 5.

c. If the sample temperature differs more than 2°C from the buffer solutions, adjust for the temperature differences.

d. Thoroughly rinse the electrode with distilled water.

e. Immerse the electrode in-situ when possible or in a grab sample. Swirl the electrode at a constant rate until the meter reading reaches equilibrium. The rate of stirring used should minimize the air transfer rate at the air-water interface of the sample.

f. Note and record sample pH; repeat measurement on successive volumes of

b. Errors due to the presence of sodium at pH levels greater than 10 can be reduced or eliminated by using a "low sodium error" electrode.

c. Coatings of oily material or particulate matter can impair electrode response. Remove these coatings by gentle wiping with a laboratory tissue followed by a distilled water rinse.

d. Temperature effects on the electrometric measurement of pH are controlled by using instruments having temperature compensation or by calibrating the electrode meter system at the temperature of the samples.

e. Poorly buffered solutions with low specific conductance values (less than 10 umhos) may cause fluctuations in the pH readings. Equilibrate electrode by immersing in several portions of sample before taking pH measurement.

(4) Reagents. Secondary standard buffer solutions (pH 4, pH 7, and pH 10) purchased from commercial vendors shall be used.

(5) Buffering

a. Follow the instructions provided with each type of pH meter.

field trip. In case of an apparent pH violation, the electrode shall be checked with pH 7.0 buffer and recalibrated to the closest reference buffer. Then the sample shall be retested. Duplicate analyses should agree within 0.1 standard units.

(c) Records -- A logbook shall be maintained and will contain the property number of each pH meter. All calibrations and repairs should be noted in the logbook indicating the date, repairs made, person making repairs, and calibration records.

(d) Reporting Units -- Report pH to the nearest 0.1 standard unit.

(e) Method for Measuring pH.

(1) Scope and Application. This method is applicable to ground, surface, and saline waters, as well as domestic and industrial wastes.

(2) Summary of Method. The pH of a sample is determined electrometrically using either a glass electrode in combination with a reference potential or a combination electrode, and a pH meter.

(3) Interferences

a. The glass electrode, in general, is not subject to solution interferences from color, turbidity, colloidal matter, oxidants, reductants, or high salinity.

(5) Precision and Accuracy. Precision and accuracy for this method have not been determined.

(6) References.

Standard Methods for the Examination of Water and Wastewater, 15th Edition, p. 124, Method 2122

Methods for Chemical Analyses of Water and Wastes, US-EPA, 170.1 (1979).

5.4.1.2 pH.

(a) Equipment -- Only electronic (portable) meters with provisions for temperature compensation should be used. Temperature resistant combination electrodes should be used in conjunction with the meters. (pH test paper will be used only for determining pH ranges or for determining approximate pH values.)

(b) Equipment Inspection and Calibration -- The pH meter shall be checked before each field trip for any mechanical or electrical failures, weak batteries, and cracked or fouled electrodes. The slope of the meter shall also be checked initially with three fresh standard buffer solutions (e.g., 4, 7, and 10). All pH recorders shall be checked for recording accuracy and time scale accuracy. While in the field, the meter shall be calibrated daily before use with two buffers bracketing the expected sample pH. Thereafter, the meter shall be checked against two buffers before each reading. Fresh buffer solutions should be used for each

(e) Method for Measuring Temperature

(1) Scope and Application. This method is applicable to ground, surface, and saline waters as well as domestic and industrial waste.

(2) Summary of Method. Temperature measurements may be made with any high quality mercury-filled thermometer or thermistor with analog or digital read-out device.

(3) Comments. Measurement device shall be routinely checked against a precision thermometer.

(4) Test Procedure.

a. Use only a previously calibrated mercury-filled thermometer or thermistor that has been inspected according to the procedure outlined above.

b. Allow thermometer or thermistor enough time to equilibrate to outside temperature when removed from a field vehicle.

c. Insert thermometer or thermistor in-situ when possible or in a grab sample. Swirl the thermometer or thermistor in the sample and take the temperature reading when the mercury column or read-out needle moves less than 1°C per minute; record temperature to the nearest 0.5°C.

(b) Inspection and Calibration -- Each glass mercury filled thermometer shall be inspected before each field trip to see that it is not cracked and does not have air spaced in the mercury column. If a mechanical dial-type thermometer is used, it should not have a broken face cover or otherwise show damage. A cross-check with a calibrated NBS certified thermometer shall be made at least semi-annually. Thermistors and electronic readout units should be calibrated in the same manner. Recording thermometers shall be checked for recording accuracy before each use. The recorder time scale accuracy shall be checked semi-annually. Before using a thermometer in the field, a visual observation shall be made to assure that it has not been damaged. If a thermistor is used, the instrument shall be checked against a thermometer before field use. Cross-checks and duplicate field analyses should agree within $\pm 0.5^{\circ}C$.

(c) Calibration Records -- A logbook shall be maintained with each thermometer number and/or equipment property number recorded. All calibration information, individuals making the calibrations, and dates of calibration, shall be recorded. Each field calibration shall be noted in the field logbook indicating the temperature readings observed.

(d) Reporting Units -- Report all temperature data to the nearest $0.5^{\circ}C$.

5.4.1 Quality Control Procedures

Quality assurance procedures for field analysis, and field analytical and test instrumentation calibration are described in the BSAP-QAPP. All field analytical procedures shall be conducted in duplicate at a minimum of 10 percent of the time. A record of these duplicate analyses shall be kept in field logbooks by field sampling personnel. A significant difference in the replicate analyses (greater than specified in the following sections) shall result in recalibration of the instruments used, re-examination of the analytical methodology being used, or re-examination of the sampling location.

All field analyses must be traceable to the specific individual performing the analyses and to the specific equipment utilized. This information shall be entered into the field logbooks for all field analyses. Time records shall be kept in local time utilizing the military 2400 hour format and shall be recorded to the nearest five minutes.

A specific calibration and/or standardization plan for all field analytical equipment is presented in this subsection. Included in this plan are: calibration and maintenance intervals; listing of required calibration standards; environmental conditions requiring recalibration; and use of a logbook to record calibration and maintenance data for each piece of field analytical equipment.

5.4.1.1 Temperature.

(a) Initial Calibration -- All thermometers shall be initially calibrated against a National Bureau of Standards (NBS) certified thermometer or one traceable to NBS certification.

ATTACHMENT A.

STANDARD CLEANING PROCEDURES

ATTACHMENT A. STANDARD CLEANING PROCEDURES

A.1 Introduction

The cleaning procedures outlined in this attachment are to be used by all personnel to clean sampling and other field equipment. Specific cleaning procedures are presented in the following section. Any deviation from them must be documented in field records.

A.1.1 Cleaning Materials

The cleaning materials referred to in this attachment are defined in the following paragraphs and also in the BSAP-QAPP.

The laboratory detergent shall be a standard brand of phosphate-free laboratory detergent such as Micro™, Alquinox™, or Liquinox™. The use of any other detergent must be justified and documented in the field logbooks and inspection or investigative reports.

The nitric acid or hydrochloric acid solution (10 percent) shall be made from reagent-grade nitric acid or hydrochloric acid and deionized water.

The standard cleaning solvent shall be laboratory-grade isopropanol. However, solvents may be substituted for a particular investigation if needed. Laboratory-grade acetone or methanol are both acceptable. However, it should be noted that if laboratory-grade acetone is used, the detection of acetone in samples collected with acetone rinsed equipment is suspect. Laboratory-grade methanol is much more hazardous to use than either laboratory-grade isopropanol or acetone, and its use is discouraged. The use of any solvent other than laboratory-grade isopropanol for equipment cleaning purposes must be justified and

its use must be documented in field logbooks. Tap water may be used from any municipal water treatment system.

Deionized water is defined as tap water that has been treated by passing through a standard deionizing resin column. The deionized water should contain no heavy metals or other inorganic compounds (i.e., at or above analytical detection limits). Organic-free water is defined as tap water that has been treated with activated carbon and deionizing units. Organic-free water should contain no pesticides, herbicides, extractable organic compounds, and less than detection limits of purgeable organic compounds.

During cleaning operations, the substitution of a higher grade water (i.e., deionized or organic-free water for tap water) is permitted and need not be noted as a variation of this BFSP. However, the deionized and organic-free water utilized must be subjected to the specific quality control procedures as outlined below.

The brushes used to clean equipment as outlined in the various sections of this attachment shall not be of the wire-wrapped type.

A.1.2 Marking and Segregation of Used Field Equipment

Field or sampling equipment that needs to be repaired shall be identified with a tag. Field equipment needing cleaning or repairs shall <u>not</u> be stored with clean equipment, sample tubing, or sample containers. Field equipment, disposable sample containers, and sample tubing that are not used during the course of an investigation may <u>not</u> be replaced in storage without being recleaned if these materials are transported to a facility or study site where herbicides, pesticides, organic compounds, or other toxic materials are present or suspected of being present, if in

the opinion of the field investigator they may have become contaminated during the course of the field investigation.

A.1.3 Decontamination of Equipment Used to Collect Samples of Toxic or Hazardous Waste

Equipment that is used to collect samples of hazardous materials or toxic wastes or materials from hazardous waste sites, RCRA facilities, or in-process waste streams shall be decontaminated before it is returned from the field. At a minimum, this decontamination procedure shall consist of washing with laboratory detergent and rinsing with tap water. More stringent decontamination procedures may be required, depending on the waste sampled.

A.1.4 Proper Disposal of Cleaning Materials

The solvent used to rinse sampling equipment and containers shall be collected and disposed of by allowing it to evaporate under a fume hood or be containerized and disposed of through an approved hazardous waste disposal contract. Similarly, spent acid shall be collected and disposed of through the same disposal contract.

A.1.5 Safety Procedures to be Utilized During Cleaning Operations

The materials used to implement the cleaning procedures outlined in this attachment can be dangerous if improperly handled. Due caution must be exercised by all personnel and all applicable safety procedures shall be followed. At a minimum, the following precautions shall be taken in the field during these cleaning operations:

1. Safety glasses with splash shields or goggles, neoprene gloves, and a neoprene laboratory apron will be work during all cleaning operations.

2. All solvent rinsing operations will be conducted in the open (never in a closed room).

3. No eating, smoking, drinking, chewing, or any hand to mouth contact shall be permitted during cleaning operations.

A.1.6 Storage of Field Equipment and Sample Containers

All field equipment and sample containers shall be stored in a contaminant-free environment after being cleaned using the procedures outlined in this attachment.

A.2 Specific Quality Control Procedures for Cleaning Operations

This section establishes guidelines for specific quality control procedures to monitor the effectiveness of the sampling equipment and sample container cleaning procedures outlined in this attachment. These procedures are specified in the BSAP-QAPP in Section 4.1.4.

A.3 Cleaning Procedures for Teflon™ or Glass Field Sampling Equipment Used for the Collection of Samples for Organic Compounds and/or Metals Analyses*

1. Teflon™ or glass sampling equipment will be rinsed thoroughly with tap or deionized water in the field as soon as possible after use.

2. Equipment will be washed thoroughly with laboratory detergent and water using a brush to remove any particulate matter or surface film.

3. The equipment will be rinsed thoroughly with deionized/organic-free water.

4. Equipment will be rinsed twice with solvent (isopropanol).

5. Equipment will be rinsed thoroughly (three times) with deionized water.

6. Equipment will be allowed to air dry.

7. Equipment will be wrapped completely with aluminum foil to prevent contamination during storage and/or transport to the field.

* - When this sampling equipment is used to collect samples that contain oil, grease or other hard to remove materials, it may be necessary to rinse the equipment several times with pesticide-grade acetone to remove the materials before proceeding with Step 2. In extreme cases, it may be necessary to steam clean the field equipment before proceeding with Step 2. If the field equipment cannot be cleaned utilizing these procedures, it should be discarded.

A.4 Cleaning Procedures for Stainless-Steel or Metal Sampling Equipment Used for the Collection of Samples for Trace Organic Compounds and/or Metals Analyses*

1. Rinse the stainless-steel or metal sampling equipment thoroughly with tap water or deionized/organic-free in the field as soon as possible after use.

2. Wash equipment thoroughly with laboratory detergent and water using a brush to remove any particulate matter or surface film.

3. Rinse equipment thoroughly with tap water or deionized/organic-free water.

4. Rinse equipment twice with solvent (isopropanol) and allow to air dry for at least 24 hours.

5. Rinse equipment thoroughly with deionized/organic-free water.

6. Wrap equipment completely with aluminum foil to prevent contamination during storage and/or transport to the field.

* When this sampling equipment is used to collect samples that contain oil, grease or other hard to remove materials, it may be necessary to rinse the equipment several times with pesticide grade isopropanol acetone to remove the materials before proceeding with Step 2. In extreme cases, when equipment is painted, badly rusted, or coated with materials that are difficult to remove, it may be necessary to steam clean or wire brush equipment before proceeding with Step 2. Any stainless-steel sampling equipment that cannot be cleaned using these procedures should be discarded.

A.5 Miscellaneous Equipment Cleaning Procedures

A.5.1 Well Sounders to Tapes Used to Measure Ground-Water Levels

1. Wash with laboratory detergent and tap water.

2. Rinse with tap water.

3. Rinse with deionized water.

4. Equipment should be placed in a polyethylene bag or wrapped with polyethylene film to prevent contamination during storage or transit.

A.5.2 Submersible Pumps and Hoses Used to Purge Ground-Water Wells

Proceed as outlined in Section A.5.1.

A.5.3 Portable Power Augers

1. The engine and power head should be cleaned with a power washer, steam jenny, or hand washed with a brush using detergent (does not have to be laboratory detergent but should not be a degreaser) to remove oil, grease, and hydraulic fluid from the exterior of the unit. These units should be rinsed thoroughly with tap water.

A.5.4 Large Soil Boring and Drilling Rigs

1. The rig should be cleaned before being mobilized and brought on-site as outlined in Step 1 of Section A.5.3.

2. All auger flights, auger bits, drilling rods, drill bits, hollow-stem augers, split-spoon samplers, Shelby™ tubes, or other parts of the drilling equipment that will contact the soil or ground water should be cleaned as outlined in Section A.4 (including footnotes) or Section A.6 (including footnotes, if appropriate).

A.5.5 Miscellaneous Sampling Equipment

Miscellaneous sampling equipment shall be washed with laboratory detergent, rinsed with tap water, followed by a thorough

deionized water rinse, and dried before being stored. This procedure is not used for any equipment utilized for the collection of samples for trace organic compounds or metals analyses.

A.5.6 Field Analytical Equipment and Other Field Instrumentation

The exterior of sealed, water-tight equipment should be washed with a mild detergent (for example, liquid dishwashing detergent) and rinsed with tap water before storage. The interior of such equipment may be wiped with a damp cloth if necessary.

Other field instrumentation should be wiped with a clean, damp cloth; pH meter probes, conductivity probes, etc., should be rinsed with deionized water before storage.

A.5.7 Ice Chests and Shipping Containers

All ice chests and reusable containers will be washed with laboratory detergent (interior and exterior) and rinsed with tap water and air dried before storage. In the event that an ice chest becomes severely contaminated, in the opinion of the field investigator, with concentrated waste or other toxic material, it shall be cleaned as thoroughly as possible, rendered unusable, and disposed of properly.

A.6 Field Equipment Cleaning Procedures

Sufficient clean equipment will be transported to the field, when possible, so that an entire study can be conducted without the need for field cleaning. However, this is not possible for some specialized items of field equipment such as portable power augers (Little Beaver®, well drilling rigs, soil coring rigs, and other large pieces of field equipment. In addition, during particularly large scale studies, it is not practical or possible to transport to the field all of the precleaned field equipment required. The

following procedures are to be utilized when equipment must be cleaned in the field.

A.6.1. Equipment Used for Routine Sample Collection Activities

For routine operations involving classic parameter analyses, water-quality sampling equipment such as Kemmerers, buckets, DO dunkers, dredges, etc., may be cleaned with sample or deionized water between sampling locations. A brush may be used to remove deposits of material or sediment, if necessary. If deionized water is used, water samplers should be flushed with sample at the next sampling location before the sample is collected. It should be emphasized that these procedures cannot be used to clean equipment for the collection of samples for organic compounds or trace metals analyses.

Flow measuring equipment such as weirs, staff gages, velocity meters, and other stream gaging equipment may be cleaned with tap water after use between measuring locations, if necessary.

A.6.2 Teflon™, Stainless-Steel, or Metal Equipment Used to Collect Samples for Organic Compounds and Trace Metals Analyses*

1. Clean with tap water and laboratory detergent using a brush if necessary to remove particulate matter and surface films.

2. Rinse thoroughly with tap or deionized water.

3. Rinse twice with solvent (isopropanol).

4. Rinse thoroughly with deionized/organic-free or distilled water.

5. Rinse thoroughly with deionized/organic-free or distilled water and allow to air dry as long as possible.

6. Wrap with aluminum foil, if appropriate, to prevent contamination if equipment is going to be stored or transported.

* Portable power augers (such as the Little Beaver®) or large soil boring or drill rigs should be cleaned as outlined in Step 1 of Section A.5.3 before boring or drilling operations.

ATTACHMENT B.

SAMPLE SHIPPING PROCEDURES

ATTACHMENT B. SAMPLE SHIPPING PROCEDURES

B.1 Introduction

Samples collected during field investigations or in response to a hazardous materials incident must be classified by the project leader, prior to shipping by air, as either environmental or hazardous material samples. In general, environmental samples include drinking water, ambient ground and surface water, background/control soils, sediment, treated municipal and industrial wastewater effluents, biological specimens, or any samples not expected to be contaminated with high levels of hazardous materials. The shipment of samples designated as environmental samples are not regulated by the U.S. Department of Transportation (US-DOT). However, these samples must be transported in such a manner as to preserve their integrity.

Samples collected from process wastewater streams, drums, bulk storage tanks, or soil, sediment, or water samples from areas suspected of being highly contaminated may need to be shipped as a hazardous material. Regulations for packing, marking, labeling, and shipping of hazardous materials and wastes are promulgated by the US-DOT and are described in the Code of Federal Regulations (40 CFR 171 through 177). The guidance for complying with US-DOT regulations in shipping environmental laboratory samples is given in the "National Guidance Package for Compliance with Department of Transportation Regulations in the Shipment of Environmental Laboratory Samples". It is the responsibility of the Contractor to insure that samples classified as hazardous materials are shipped in accordance with these regulations.

B.2 Shipment of Environmental Samples

Samples collected by field personnel and designated by the field team leader as environmental samples shall be shipped using

the method described below. However, if the environmental samples are preserved, the amount of preservative must not exceed the amounts indicated in Table 1 of this attachment. If the amount of preservative added to a sample exceeds that listed in Table 1, then that sample may be considered a hazardous material and shall be shipped in accordance with procedures described in 49 CFR 171 through 177. In addition, the shipment of pre-preserved sample containers or bottles of preservatives (i.e., NaOH pellets, HCl, etc.) which are designated as hazardous under the US-DOT, Hazardous Materials Tables, 49 CFR 172.101, must be shipped pursuant to the appropriate US-DOT regulations. The shipment of nitric acid is forbidden on all aircraft.

Environmental samples shall be packed prior to shipment by air using the following procedures:

1. Select a sturdy cooler in good repair. Secure and tape the drain plug with fiber tape. Line the cooler with a large heavy duty plastic bag.

2. Allow sufficient outage (ullage) in all bottles (except VOCs) to compensate for any pressure and temperature changes (approximately 10 percent of the volume of the container).

3. Be sure the lids on all bottles are tight (will not leak) and then secure the lid to the bottle with tape (preferably plastic electrical tape) to insure the lid will not vibrate loose during transport.

4. Place all bottles in separate and appropriately sized polyethylene bubble pack bags and seal the bags with tape (preferably plastic electrical tape).

5. Place paired 40-ml VOC vials into separate polyethylene bubble pack bags and seal with tape.

6. Place plastic bags filled with ice in the bottom of the cooler and then place the bottles and cans in the cooler with sufficient space to allow for the addition of additional bags of ice.

7. Securely fasten the top of the large garbage bag with tape (preferably plastic electrical tape).

8. Place completed chain-of-custody forms into the cooler and then close the cooler and securely tape (preferably with fiber tape) the top of the cooler shut. Chain-of-custody seals should be affixed to the top and sides of the cooler so that the cooler cannot be opened without breaking the seal.

9. The shipping containers must be marked "THIS END UP," and arrow labels which indicate the proper upward position of the container should be affixed to the container. A label containing the name and address of the shipper shall be placed on the outside of the container. Labels used in the shipment of hazardous materials (such as Cargo Only Aircraft, Flammable Solids, etc.) are not permitted to be on the outside of the container used to transport environmental samples and shall not be used.

Table 1. Chemicals Listed in the Hazardous Materials Table (49 CFR 172.101) Used by ESD for Preserving Samples

Preservative	Sample Type/Parameter	pH Recommendation	Quantity of Preservative Added Per Liter	Wt. % of Preservative
HCl	Volatile Organic Analysis	<2 - ≥1	4 drops conc. HCl/40 ml	0.22% (2)
$HgCl_2$	Nitrogen Species	NA	40 mg	0.004% (1)
HNO_3	Metals, Hardness	<2 - ≥1	5 ml of conc. (70%)	0.35% (1)
H_2SO_4	Nitrogen Species COD, Oil & Grease, Organic Carbon, Phenols	<2 - ≥1	2 ml of 36N	0.35% (1)
NaOH	Cyanides, Sulfides	>12 - ≤13	2 ml of 10N	0.080% (1)
Freezing* 0°C (Dry Ice)	Biological - Fish and Shellfish Tissue	NA	NA	NA

* Dry ice is classified as a ORM-A hazard by DOT. There is no labeling requirement for samples preserved with dry ice, but each package must be plainly and durably marked on at least one side or edge with the designation "ORM-A." The package should also be marked "Dry Ice" or "Carbon Dioxide, Solid" and "Frozen Diagnostic Specimens." Samples must be packaged in accordance with the requirements of 40 CFR 173.615 and advance arrangements must be made between the shipper and each carrier.

NA Not Applicable

ATTACHMENT C.

STANDARD OPERATING PROCEDURES FOR FIELD FILTRATIONS OF WATER SAMPLES

STANDARD OPERATING PROCEDURE
FIELD FILTRATION OF WATER SAMPLES

If water samples are to be tested for dissolved constituents, eg. metals, they must be filtered prior to preservation. Water samples must be filtered through a 0.45 micron pore-size filter to remove suspended particulate matter. Samples for analysis of volatile compounds should not be filtered.

The filtering equipment and membrane must be suitable for the intended analysis. Materials known to adversely affect the analytical procedure must not be used. The principal guidance elements regarding filtration can be summarized as follows.

When to filter:

- When the water sample is produced from medium to fine-grained porous geologic material and contains suspended fines that cannot be prevented by well development or by well design.
- To determine the soluble organic or inorganic chemical constituents that are considered to be transported by ground water through an unconsolidated aquifer.
- To determine the radionuclide content of water that would be expected to be transmitted in an aquifer.
- When iron concentration in the water is elevated to a few or more parts per million.
- When it is important to determine the flux of chemical constituents for purposes of meeting water quality or developing data for a model.

Filtration must be done as soon as possible after a water sample is obtained, preferably simultaneously with the production of the water, i.e. in-line. Where possible, the standard procedure should be to use an in-line flow-through filter. A delay in filtration is most critical if the water sample has a relatively high iron concentration. Precipitating iron oxide has a substantial capacity for sorbing metal ions and some organics. The procedures for collecting a filtered sample is described as follows.

1. Use a nose piece, molded, in-line high capacity disposable 0.45 micron filter.

2. Filter material should be non-contaminating synthetic fibers.

3. Filter should be placed on the positive pressure side of the peristaltic pump.

4. If the well is deeper than 25 feet, a submersible pump may be necessary to bring the sample to surface. Once the sample has been brought to the surface and collected into a clean container, the sample should be passed through the in-line filter using the peristaltic pump (equipped with a shorter length of tubing) as described above. The sample is transferred from one container to the second container through the in-line filter, using the peristaltic pump.

5. When filtering a sample, at least one filtered equipment blank using deionized/organic-free water must be collected and analyzed.

When not to filter:

- When aquifer is open, that is, has solution cavities or has extremely large pores (a gravel aquifer) and particulate matter is identified as a natural part of the mobile phase of the aquifer.

- Wells can produce water with colloidal matter that will clog a 0.45 micron pore-size membrane. Wells producing such water have been observed with yields of hundreds of gallons per minute. In such an unusual case a representative water sample would not be filtered.

- When the objective is to measure exposure of people to ground-water constituent, samples are collected from access points in the distribution system. An example would be water from a residential well collected at a sink.

- When gaseous radioactive isotopes are being measured.

- When volatile organic compounds are analytes of interest. An exception would be completely contained flow-through filtration system. Such a system should have little effect on dissolved volatile organic compounds.